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Pepper Cultivation in India

A Survey-based quantitative description of pepper cultivation

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A Survey-based Quantitative Description of Pepper Cultivation

Contents **page**

1 Introduction

In this paper we have presented a quantitative description of pepper cultivation in India. The purpose of the description is to obtain a characterisation of pepper farmers, pepper production and the area allocated to pepper cultivation. The survey among pepper farmers, used as a basis for this description, makes it possible to give an estimate of area and production in pepper cultivation. Production estimates are given in the course of this study, while an attempt at estimating area in a meaningful way is implemented in the appendix. In this appendix the sample design is also explained, and the questionnaire used for the survey is presented. The survey data will also be used to construct a vintage model of pepper cultivation in India: such a model enables an exploration of possible developments in area and production in the medium term, say for a period of 3 to 5 years. This is implemented in a related paper (see Cheriankunju, Jagadeesan, Sree Kumar and Zant, 'Pepper cultivation in India, a vintage model of pepper production : forecasting the medium term' (1999)). The main findings from the survey are compared with other studies on pepper cultivation in India (see e.g. Sarma and Premkumar (1988), Sarma et al. (eds., 1992); George et al. (1989)).

The survey used to obtain information about the cultivation of pepper, was fielded from August to November 1997 and covers 2501 farm households. Pepper is grown in the south of India, in the state of Kerala, and also in smaller proportions in Karnataka and Tamil Nadu, and, hence, the households in the sample are located in these states. The sample distinguishes 25 districts: all 14 Kerala districts, 6 districts in Karnataka and 5 in Tamil Nadu. Because of their relatively minor importance the sample size is small in Karnataka and Tamil Nadu.

The source of the sample for the state of Kerala is an earlier survey by the Department of Economics and Statistics in Trivandrum. To correct their sample for attrition, the sample is complemented with names provided by Krishi Bhavan and collected by the Spices Board. In the case of Kerala we have also made use of (parts of) the sample design of the research of the Department of Economics and Statistics of Trivandrum in the current work. For the states of Karnataka and Tamil Nadu a different approach is taken: the cultivation of pepper is related to coffee or arecanut (see also the tables on crop combinations in these states in a following part of this section), and data for these crops are used to weigh the sample. Details on the sample design and the resulting procedures to arrive at country wide aggregates are set out in the appendix. Throughout this report all the presented data are results from the sample survey adjusted with proper weights, which are discussed in the appendix.

2 All crops: area, cultivation type and crop combinations

The focus of the survey is to characterise the cultivation of pepper. Nevertheless, a number of questions in the questionnaire pertain to all agricultural activities of farm households. These mainly concern the size and composition of plots and the choice of crops. In this section we have reported these issues. It should be noted that throughout this section the total household and cultivation of all crops are considered. Table 1 summarises the distribution of observations and total cultivated area in the sample, by state and district. From the table it is observed that the larger part of the survey is fielded in Kerala: 2299 of a total of 2501 farm households are located in Kerala. The small number of observation in a few districts (e.g. Shimoga,

Coimbatore, and Kanyakumari) should make us cautious when drawing conclusions from district-wise information. These districts only qualify to be analysed jointly with other districts to get meaningful results.

Table 1 District wise distribution of observations, total area and farm size

	number of observations	aggregate area in ha	aggregate area share in %	farm size in acres average	farm size in acres standard deviation	farm size in acres minimum	farm size in acres maximum
Kerala							
Alappuzha	26	4918	0.7	0.6	0.8	0.1	4
Ernakulam	68	29081	3.9	1.7	1.5	0.1	6
Idukki	554	69760	9.3	2.7	2.4	0.1	25
Kannur	394	95995	12.8	2.2	2.1	0.1	15
Kasargode	75	24145	3.2	2.3	2.0	0.1	10
Kollam	103	22076	2.9	1.9	1.9	0.1	15
Kottayam	107	27542	3.7	2.4	2.9	0.2	20
Kozhikode	158	27215	3.6	2.5	2.2	0.2	21
Malappuram	104	22616	3.0	1.9	2.0	0.2	14
Palakkad	43	9511	1.3	2.5	2.0	0.2	10
Pathanamthitta	62	17012	2.3	1.7	1.7	0.0	10
Thiruvananthapuram	71	17822	2.4	1.5	1.7	0.2	9
Thrissur	48	10688	1.4	1.2	1.7	0.2	15
Wayanad	486	118405	15.8	4.4	36.4	0.1	820
All Kerala	2299	496786	66.2	2.3	13.0	0.0	820
Karnataka							
Chickmagalur	49	62773	8.4	100.1	235.0	7.0	1645
Dakshina Kannada	19	22563	3.0	16.7	19.5	2.5	88
Hassan	19	29259	3.9	43.6	29.0	11.0	108
Kodagu	51	77025	10.3	34.8	36.5	3.5	200
Shimoga	2	20280	2.7	23.2	19.4	9.5	37
Uttara Kannada	11	9112	1.2	8.4	10.5	1.5	38
All Karnataka	151	221013	29.4	32.4	78.9	1.5	1645
Tamil Nadu							
Coimbatore	1	2808	0.4	431.0	.	431	431
Dindigul	18	15058	2.0	23.6	36.3	2	150
Kanyakumari	5	137	0.0	19.2	23.8	1.5	50
Nilagiri	15	8481	1.1	17.7	41.9	1	165
Salem	12	6431	0.9	123.3	153.4	1.5	514
All Tamilnadu	51	32915	4.4	27.8	60.9	1	514

Source: Spices Board (SB), Economic and Social Institute (ESI-VU), 1997
Note: Due to the weighing it is not possible to calculate average farm size from total area.

From the table it is immediately obvious that the scale of farm households differs dramatically between the states. The Kerala average total size of cultivated area per household is 2.3 acres with a maximum of 4.8 acres in Wayanad[2] and a minimum of 0.6 acres in

[2] The average farm size in Wayanad is relatively high within Kerala (twice the all Kerala average). This is, however, due to one observation of a farm with a size of 820 acres. If this observation is omitted the Wayanad average declines to 2.8 acres.

Alappuzha, while the Karnataka and Tamil Nadu average is more than 10 times higher (resp. 32.4 and 27.8 acres), with, admittedly, a much larger standard deviation. In Karnataka and Tamil Nadu the sample covers mainly large estates: in these states pepper is cultivated in large coffee estates except in Dakshina Kannada and Uttara Kannada. The average holding size in these states (see Table 1) clearly underscores this. The large average size of Coimbatore (431.0 acres, one observation!) and Salem (123.3 acres) in Tamil Nadu and Chickmagalur (100.1 acres) in Karnataka stand out[3].

Three different types of cultivation may be distinguished among the farmers in our survey: homestead cultivation, mixed cropping or inter cropping, and mono cropping. Homestead cultivation pertains to cultivation of crops around the house in an unsystematic way, possibly scattered over the area and distinct from more systematic crop cultivation. Area allocated to this type of cultivation should be marginal in terms of total cultivated area. Under homestead conditions the quantity harvested by individual growers is small and the produce is offered in small lots to the market. Mixed cropping (also referred to as multi cropping or inter cropping) is the cultivation of plots with a variety of crops. This type of cultivation is widely practised and pertains to a large number of different combinations of crops and different planting densities. By nature it is difficult to give an accurate empirical characterisation of mixed or inter cropping. Such a characterisation is, however, attempted in the final part of this section. Mono cropping refers to exclusive cultivation of plots with one crop. In the case of pepper cultivation in India mono cropping is claimed to be rare, while mixed cropping is claimed to be the most popular type of cultivation.

The concept of homestead cultivation, however, appeared to be difficult to quantify accurately. A clear-cut unequivocal definition of homestead cultivation applicable in a practical and uniform way is difficult to establish. This leaves scope for interpretation by the interviewers and by the interviewed farmers, leading to rather subjective measurement of area under homestead cultivation. As both number of vines and area attributed to homestead cultivation pertain to very small quantities, marginal errors in reporting either of these will cause large errors in calculated densities, errors which are on average much larger than in calculated densities for mixed cropping and mono cropping. This problem is immediately evident if densities of different types of cultivation are compared: earlier calculations (not presented in this report) have shown that average densities in homestead cultivation are in many districts higher than average densities in mixed cropping and in a few case come close to average densities in mono cropping! For these reasons it has been decided in the remainder of this study to add homestead cultivation to mixed cropping: after all, almost without exception more than one crop is cultivated on the homestead (which, in itself adds to the susceptibility to different interpretations of the interviewer).

Table 2 summarises the aggregate area and the average farm area by type of cultivation and by district[4]. It should be recalled, as mentioned above, that the tables in this section

[3] In the case of Chickmagalur this average is biased by one observation of 1645 acres: without this observation the average decreases to 65 acres.

[4] We adopted the convention of using acres as a unit of area size in the case of farm household data, while we have used hectares as a unit of area size in the case of aggregates on e.g. district or state level. One (1) acre is equivalent to 0.4047 hectare.

Table 2 Aggregate area and average area per farm by type of cultivation *

	aggregate cultivated area by type of cultivation **				area per farm by type of cultivation**			
	in ha's		share in %		in acres (average)		share in % (average)	
Kerala	**mixed**	**mono**	**mixed**	**mono**	**mixed**	**mono**	**mixed**	**mono**
Alappuzha	4196	722	85.3	14.7	0.5	0.1	96.1	3.9
Ernakulam	27250	1832	93.7	6.3	1.6	0.1	96.5	3.5
Idukki	53967	15794	77.4	22.6	2.1	0.6	86.8	13.2
Kannur	90493	5503	94.3	5.7	2.1	0.1	96.3	3.7
Kasargode	22589	1556	93.6	6.4	2.1	0.1	96.4	3.6
Kollam	15743	6334	71.3	28.7	1.4	0.6	81.1	18.9
Kottayam	14638	12905	53.1	46.9	1.3	1.1	74.0	26.0
Kozhikode	23244	3971	85.4	14.6	2.2	0.4	89.3	10.7
Malappuram	15860	6756	70.1	29.9	1.4	0.6	85.7	14.3
Palakkad	7216	2295	75.9	24.1	1.9	0.6	84.8	15.2
Pathanamthitta	9399	7614	55.2	44.8	0.9	0.8	74.1	25.9
Thiruvananthapuram	14416	3406	80.9	19.1	1.2	0.3	89.2	10.8
Thrissur	10558	130	98.8	1.2	1.2	0.0	99.5	0.5
Wayanad	106801	11606	90.2	9.8	4.0	0.4	88.3	11.7
All Kerala	416369	80424	83.8	16.2	2.0	0.4	89.7	10.3
Karnataka								
Chickmagalur	58198	4576	92.7	7.3	92.8	7.3	86.4	13.6
Dakshina Kannada	13005	9558	57.6	42.4	9.6	7.1	75.8	24.2
Hassan	19871	9389	67.9	32.1	29.6	14.0	70.1	29.9
Kodagu	63914	13112	83	17	28.9	5.9	82.9	17.1
Shimoga	9813	10467	48.4	51.6	11.2	12.0	59.7	40.3
Uttara Kannada	6091	3021	66.8	33.2	5.6	2.8	79.9	20.1
All Karnataka	170892	50123	77.3	22.7	25.1	7.3	77.1	22.9
Tamil Nadu								
Coimbatore	2808		100		431		100	
Dindigul	15058		100		23.6		100	
Kanyakumari	137		100		19.2		100	
Nilagiri	8465	16	99.8	0.2	17.7	0.0	99.2	0.8
Salem	6431		100		123.3		100	
All Tamilnadu	32899	16	100	0.0	27.8	0.0	99.7	0.3

Source: SB, ESI-VU, 1997

* Due to missing variables the information in different tables may not fully correspond

** This table pertains to the cultivated area of all crops, not only pepper

pertain to all cultivated crops. The difference between the distribution of mixed and mono cropping in the right and the left side of the table is caused by the relative size of the farm households of the survey: in the right part all farmers, both large and small, contribute in an equal way to the average composition of the farm by type of cultivation, while the aggregation in the left part weighs each farmer with the relative sizes. The tables confirm the importance of mixed cropping: this type of cultivation is most popular in all three states. The average per farm share of mixed cropping in total cultivated area and for the state aggregate is, in Kerala, 89.78% and 83.8%, in Karnataka 77.1% and 77.3% and in Tamil Nadu 99.7% and 100%. Mono

cropping is almost non-existent in Tamil Nadu. The larger share of aggregate mixed cropping area on a district level relative to the average per farm share of mixed cropping suggests that mono cropping is done to a larger extent by larger farmers. The largest shares of mono cropping are observed mainly in Kerala, in Pathanamthitta, Kottayam, Malapurram and Kollam. This is largely due to the domination of natural rubber cultivation in these districts (again, recall that in this section all crops are considered, not only pepper). Typical low shares of mono cropping are reported in Ernakulam, Kannur, Kasargod and Thrissur.

Because of the importance of mixed cropping, as is evident from Table 2, an attempt is made to characterise the major crop combinations in each district. Crop combinations are identified by asking the farmer to enumerate, for each parcel in his plot, all crops cultivated up to a maximum of five different crops per parcel. With many potential crops (more than 20) a large number of combinations per parcel are possible. The presentation of the information on crop combinations is organised in two ways: in Table 3 the three most popular combinations in each district and their share in total mixed cropping is summarised. It should be noted that the crop combination in this table pertains to one unique crop combination of five crops. This combination excludes all other crop combinations as all five crop options per parcel are specified, also if no crops are cultivated. In Table 4, on the other hand, the most popular combinations of respectively, two and three crops, in terms of their share in total mixed cropping, is selected. This combination may be supplemented with respectively three and two other crops, which could be any crop. At the outset combinations of crops in mixed cropping do not necessarily include pepper. However, under mixed cropping system the crop combinations including pepper appeared to dominate. The other major crops cultivated by our survey farmers are mainly cultivated under mono cropping system. Finally, and again, it should be emphasised that one should be cautious in drawing conclusions if the number of observations is small (see Table 1): in a number of districts this is the motivation for not reporting the major crop combination.

From Table 3 and Table 4 the following picture emerges. In Kerala pepper is cultivated mainly in combination with coconut and arecanut. The districts Ernakulam (pepper, coconut, natural rubber), Idukki (pepper, coffee, cardamom), Kottayam, Alapuzha (both pepper, coconut, plantain) and Wayanad (pepper, coffee, coconut) are exceptions. In all these districts, however, the combination pepper, coconut and arecanut is also very popular. In Karnataka and Tamil Nadu the predominant combination of crops in mixed cropping is pepper and coffee, combined with either arecanut or cardamom. Coffee, as a component in mixed cropping is, however, of little importance in Dakshina Kannada and Uttara Kanada. It should noted, however, that the predominance of coffee in these districts is a direct result of the procedure to obtain sample observations (see sample design).

Table 3 Major crop combinations in mixed cropping by district *

District	Major crop combinations					
	Crops	Share in total mixed cropping area in %	Crops	Share in total mixed cropping area in %	Crops	Share in total mixed cropping area in %
Kerala						
Alappuzha	pepper, coconut, arecanut, plantain	38.9	pepper, coconut, plantain	4.6		
Ernakulam	pepper, coconut	18.6	pepper, coffee, coconut, rubber	5.6	pepper, coconut, arecanut	3.6
Idukki	pepper, coffee, cardamom, coconut, arecanut	10.0	pepper, coffee, cardamom	8.0	pepper, coffee	7.7
Kannur	pepper, coconut, arecanut	10.3	pepper, coconut, arecanut, cashew, rubber	6.1	pepper, coconut, arecanut	6.1
Kasargod	pepper, coconut, arecanut	16.2	pepper, coconut, arecanut, cashew	4.3		
Kollam	pepper, coconut, arecanut	11.3	pepper, coconut, arecanut, plantain	9.6	pepper, coconut, plantain	3.9
Kottayam	pepper, coconut, arecanut, rubber	3.5	pepper, coconut, plantain	3.4	pepper, coffee, coconut, plantain	2.7
Kozhikode	pepper, coconut, arecanut	63.9	pepper, coconut, arecanut, plantain	9.5		
Malappuram	pepper, coconut , arecanut	32.7	pepper, coconut	10.0		
Palakkad	pepper, coconut , arecanut	24.0	pepper, coffee, coconut, arecanut	17.4	pepper, coconut	11.1
Pathanamthitta	pepper, coconut, arecanut, plantain	10.1	pepper, coconut, arecanut, rubber	8.2	pepper, coffee, coconut, arecanut	6.7
Thiruvananthapuram	pepper, coconut, arecanut	13.5	pepper, coconut, arecanut, plantain	13.5	pepper, coconut, plantain	10.4
Thrissur	pepper, coconut, arecanut	9.7	pepper, coconut	9.8		
Wayanad	pepper, coffee, coconut, arecanut	29.3	pepper, coffee	22.8	pepper, coffee, coconut	7.7
Karnataka						
Chickmagalur	pepper, coffee, arecanut	16.5	pepper, coffee	14.7	pepper, coffee, coconut, arecanut	7.7
Dakshina Kannada	pepper, coconut, arecanut	25.4	pepper, coconut, arecanut, plantain	13.1	pepper, coconut, arecanut, rubber	2.7
Hassan	pepper, coffee, cardamom	23.1	pepper, coffee, cardamom, coconut, arecanut	7.1	pepper, coffee	5.9
Kodagu	pepper, coffee	25.9	pepper, coffee, cardamom, arecanut	6.8	pepper, coffee, cardamom	5.4
Uttara Kannada	pepper, coffee, cardamom,arecanut	9.8	pepper, coconut, arecanut	2.4		
Tamil Nadu						
Dindigul	pepper, coffee	71.4				
Nilagiri	pepper, coffee	21.1				

Source: SB, ESI-VU, 1997

* Table 3 reports the three largest shares in total mixed cropping area of plots allocated to one specific crop combination: a specific crop combination excludes all other crops.

Table 4 Major crop combination in mixed cropping by district *

District	Combination of crops with the largest share at least containing the crops			
	Crops	Share in total mixed cropping area in %	Crops	Share in total mixed cropping area in %
Kerala				
Alappuzha	pepper, coconut, plantain	83.9	Pepper, coconut	95.9
Ernakulam	pepper, coconut, natural rubber	21.3	Pepper, coconut	48.3
Idukki	pepper, coffee, cardamom	42.1	Pepper, coffee	81.0
Kannur	pepper, coconut, arecanut	56.8	Pepper, coconut	73.2
Kasargod	pepper, coconut, arecanut	47.0	Pepper, coconut	67.2
Kollam	pepper, coconut, arecanut	57.8	Pepper, coconut	89.9
Kottayam	pepper, coconut, plantain	41.5	Pepper, coconut	93.8
Kozhikode	pepper, coconut, arecanut	87.9	Pepper, coconut	89.9
Malappuram	pepper, coconut, arecanut	74.6	Pepper, coconut	90.5
Palakkad	pepper, coconut, arecanut	62.0	Pepper, coconut	99.0
Pathanamthitta	pepper, coconut, arecanut	49.7	Pepper, coconut	82.8
Thiruvananthapuram	pepper, coconut, arecanut	42.0	Pepper, coconut	91.7
Thrissur	pepper, coconut, arecanut	14.6	Pepper, coconut	28.3
Wayanad	pepper, coffee, coconut	41.2	Pepper, coffee	70.4
All Kerala	pepper, coconut, arecanut	44.0	Pepper, coconut	64.1
Karnataka				
Chickmagalur	pepper, coffee, arecanut	65.0	Pepper, coffee	95.7
Dakshina Kannada	pepper, coconut, arecanut	48.9	Pepper, arecanut	68.6
Hassan	pepper, coffee, cardamom	36.8	Pepper, coffee	93.3
Kodagu	pepper, coffee, cardamom	19.2	Pepper, coffee	92.9
Uttara Kannada	pepper, cardamom, arecanut	78.0	Pepper, arecanut	100
All Karnataka	pepper, coffee, arecanut	33.8	Pepper, coffee	83.9
Tamil Nadu				
Dindigul			Pepper, coffee	100
Nilagiri			Pepper, coffee	31.9
Salem	pepper, coffee, cardamom	20.3	Pepper, coffee	100
All Tamil Nadu			Pepper, coffee	73.9

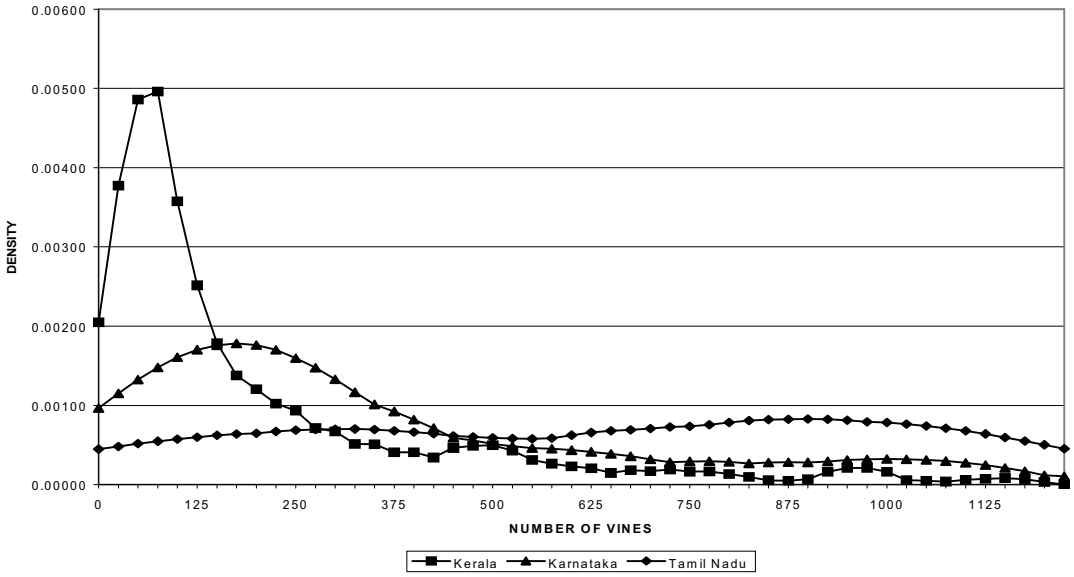
Source: SB, ESI-VU, 1997

* Table 4 reports the largest share in total mixed cropping area of plots allocated to a specific crop combination: a specific crop combination allows two other crops additional to the specified crops reported, in the first column, or three other crops additional to the specified crops in the second column.

3 Pepper cultivation: density and vines by variety

The purpose of this descriptive exercise is to learn how pepper is cultivated and to find out the distribution of pepper vines by type of cultivation, by density by variety and by age, on a district and a state level. This is implemented in the following sections. Figure 1 shows the frequency distribution of the number of vines, i.e. the number of farmers by the number of their vines, in the states Kerala, Karnataka and Tamil Nadu. The figure shows highly skewed distributions with long tails, indicating only few observations in the case of a large number of vines per farm. The figure also makes clear that the concentration of very small farms is the largest in Kerala.

Figure 1 State wise number of farmers by number of vines



In Table 5 the district and state wise aggregate number of v ines is presented, together with aggregate gross area under pepper. Gross area is defined as the size of the area that is reported to have pepper vines cultivated on, i.e. it is the size of area irrespective of the type of cultivation and the density of vines. In a later part of this study we develop a concept of area under pepper that attempts to control for differences in density. District aggregates indicate that Idukki and Wayanad are by far the largest districts in terms of pepper cultivation (47.0 and 39.6 million vines), followed by Kannur (16.6 million vines) and the Karnataka districts Kodagu and Shimoga (20.0 and 16.3 million vines). Kanyakumari, Dakshina Kannada and Alapuzha have relatively small numbers of vines. The final column in the table reports the per-district share of pepper area under mixed cropping. This column clearly confirms that pepper in India is mainly cultivated mixed with other crops. The columns on number of vines and area clearly emphasise the importance of the differences in densities: in some districts a relatively high share of area is combined with a much lower share of number of vines or vice versa. The former indicates much area with below average densities (e.g. Ernakulam, Kasargode), the latter indicates much area with above average densities (e.g. Idukki).

Table 5 Aggregate number of vines and gross pepper area

	number of vines	**share in % of column total**	**pepper area (gross) in hectares**	**share in % of column total**	**mixed cropping in %**

Kerala					
Alappuzha	707,762	0.4	4120	0.7	100
Ernakulam	2,792,748	1.4	26162	4.4	100
Idukki	47,711,452	24.6	57508	9.7	92.5
Kannur	16,575,184	8.5	77716	13.0	98.9
Kasargode	2,602,153	1.3	22192	3.7	100
Kollam	4,846,232	2.5	15537	2.6	95.0
Kottayam	4,528,272	2.3	14492	2.4	99.0
Kozhikode	5,032,974	2.6	21355	3.6	99.2
Malappuram	3,917,734	2.0	14864	2.5	99.8
Palakkad	1,871,048	1.0	7216	1.2	100
Pathanamthitta	2,153,201	1.1	8978	1.5	96.3
Thiruvananthapuram	2,895,864	1.5	14414	2.4	99.6
Thrissur	1,314,221	0.7	10601	1.8	99.6
Wayanad	39,604,616	20.4	107232	18.0	98.6
All Kerala	136,553,456	70.4	402387	67.6	97.9
Karnataka					
Chickmagalur	6,272,170	3.2	56738	9.5	100
Dakshina kannada	931,561	0.5	10411	1.7	100
Hassan	6,663,130	3.4	18600	3.1	100
Kodagu	19,962,564	10.3	60185	10.1	100
Shimoga	16,272,890	8.4	8286	1.4	100
Uttara kannada	1,500,242	0.8	6091	1.0	100
Karnataka	51,602,556	26.6	160312	26.9	100
Tamil Nadu					
Coimbatore	375,558	0.2	2808	0.5	100
Dindigul	2,996,120	1.5	15058	2.5	100
Kanyakumari	36,487	0.0	137	0.0	100
Nilagiri	998,871	0.5	8465	1.4	100
Salem	1,440,340	0.7	6431	1.1	100
Tamilnadu	5,847,376	3.0	32899	5.5	100

Source: SB, ESI-VU, 1997

In Table 6 we have presented the densities in pepper cultivation by dis trict and by type of cultivation. Density is defined as the number of stands per acre of area cultivated with pepper vines. The steps needed to obtain these densities are as follows: first, the number of vines per parcel is identified. Then the size of the area cultivated with pepper is extracted from the data set. Both calculations are implemented for the entire farm household area as well as for the area by type of cultivation. In these calculations all area is reported to be cultivated with pepper. Total pepper area per household is consequently defined as the sum of homestead, mixed cropping and mono cropping area under pepper. Parcels with mixed or mono cropping of crops other than pepper are not included. Finally, the calculated densities are given their proper sample weight for district- and state-wise aggregation.

From the table it is observed that densities for, respectively, mixed cropping, mono cropping and all types of cultivation, are in Kerala 142, 406 and 147; for all types of cultivation, densities are in Karnataka: 171 (exclusively mixed cropping) and in Tamil Nadu: 161 (almost exclusively mixed cropping). Within Kerala specifically high densities are observed in Idukki

and Wayanad. Densities for mixed cropping and mono cropping are Idukki: 306 and 509, and in Wayanad: 249 and 377. Extremely low densities are reported in Ernakulam, Kasargode, Thrissur and Dakshina Kannada.

Table 6 Density in pepper cultivation by district (stands per acre) *

		Mixed cropping	Mono cropping	All types of cultivation
Kerala				
	Alappuzha	89.3		89.3
	Ernakulam	68.3		68.3
	Idukki	306.3	508.8	318.2
	Kannur	99.0	379.3	102.3
	Kasargode	57.2		57.2
	Kollam	145.3	292.6	158.7
	Kottayam	133.6	369.2	138.2
	Kozhikode	95.0	209.2	96.8
	Malappuram	128.5	200.0	128.9
	Palakkad	111.9		111.9
	Pathanamthitta	116.7	399.9	128.2
	Thiruvananthapuram	88.6	216.7	89.7
	Thrissur	61.3	150.0	61.8
	Wayanad	248.9	376.6	251.3
	All Kerala	142.3	406.4	147.1
Karnataka				
	Chickmagalur	79.5		79.5
	Dakshina Kannada	57.4		57.4
	Hassan	167.2		167.2
	Kodagu	157.0		157.0
	Shimoga	-		-
	Uttara Kannada	121.9		121.9
	All Karnataka	171.0		171.0
Tamil Nadu				
	Coimbatore	-		-
	Dindigul	168.5		168.5
	Kanyakumari	-		75.8
	Nilagiri	162.7		162.7
	Salem	75.3		75.3
	All Tamil Nadu	166.1		160.9

Source: SB, ESI-VU, 1997
* Densities based on less than 5 observations are omitted and indicated with a bar (-)

It is possible to compare densities calculated with our survey data with other sources: George et al. (1989) report densities for a limited number of districts in Kerala[5]. For many districts the average density is in the same range (especially if we take account of the large

[5] George et al. (1989) report the following number of pepper stands per acre (table 2.4, p. 9): Ernakulam: 53; Idukki: 187; Kannur: 123; Kottayam: 136; Kozhikode: 120; Pathanamthitta: 102; Thiruvananthapuram: 130; Wayanad: 150.

standard deviations). Specifically striking is the similarity of the low densities in Ernakulam. This observation suggests that there is, perhaps little change in the cultivation of pepper, as far as density is concerned. There are, however, some notable differences: Idukki and Wayanad have much higher densities in the current study (in Idukki and Wayanad respectively 318 and 251 in the current study as opposed to 187 and 150 in George et al. (1989)). In the work of the Department of Economics and Statistics in Trivandrum a procedure is applied to calculate production and area under pepper (see also the appendix) in which a standard density of 560 stands per hectare (227 stands per acre) is applied to all districts except Idukki and Wayanad where a standard of 1000 stands (405 stands per acre) is applied. Our calculation suggest a different pattern: focusing on Kerala, the larger part of the districts have a lower average density between 56 and 170 stands per acre, with an average of around 100, with low values for Kasargode, Alapuzha, Ernakulam and Thrissur (90 stands per acre or less), and high values for Kottayam, Kollam and Malappuram (125 to 170 stands per acre), while Idukki and Wayanad have very high values (318 and 251 stands per acre). Densities in Idukki and Wayanad, however, diverge substantially from each other and from the DES standard (405 stands per acre). Densities for 'all Karnataka' and for 'all Tamil Nadu' are also around 100, and hence in the same order of magnitude as the major part of Kerala.

It should be noted that densities in our study have an extremely large sprea d: in Idukki, for example, the densities in homestead cultivation, mixed cropping and mono cropping vary in between 90-719, 9-889 and 100-900 and all have standard deviations of around 180. The large overlapping of densities with different types of cultivation prevails in almost all districts. The large spread in densities is remarkable and makes it problematic to characterise types of cultivation by the average value of this density over all households in the district.

Perhaps more insight may be obtaine d from an ordering of pepper vines by density irrespective of the crops pepper is combined with (if any). Table 7 summarises the distribution of the number of vines by density class. From the table it is observed that some districts have a marginal number of vines or no vines at all in the higher density classes: this applies for example to Ernakulam, Kasargode, Kozhikode, Malappuram Pathanamthitta, Thrissur, Chickmagalur. In these districts more than 60% of all vines, and in some districts close to 100%, is cultivated with a density of less than 200 vines per acre. In some districts, cultivation of pepper with extremely high densities is common: this applies especially to Idukki. Also high density cultivation, but on a substantially lower scale compared to Idukki is observed in Kannur, Kollam and Wayanad.

Table 7 Distribution of number of vines by density and by district
(shares of total number of vines per district in %)

District	**Density (vines per acre)**									
above	**0**	**100**	**200**	**300**	**400**	**500**	**600**	**700**	**800**	**900**
below	**100**	**200**	**300**	**400**	**500**	**600**	**700**	**800**	**900**	**1000**
Kerala										
Ernakulam	58.8	26.6	6.6	1.1	5.6	1.3	0.0	0.0	0.0	0.0

	Idukki	2.9	5.8	16.0	15.6	13.4	17.4	10.9	7.6	10.4	0.0
	Kannur	30.6	22.6	12.3	13.1	9.3	5.2	4.1	0.5	2.2	0.0
	Kasargode	60.5	38.3	0.3	0.9	0.0	0.0	0.0	0.0	0.0	0.0
	Kollam	21.1	25.2	20.1	9.6	3.8	6.0	5.1	9.2	0.0	0.0
	Kottayam	19.8	27.9	26.0	7.5	9.5	9.2	0.0	0.0	0.0	0.0
	Kozhikode	33.9	31.9	24.1	4.2	5.6	0.2	0.0	0.0	0.0	0.0
	Malappuram	32.5	28.0	18.7	17.8	3.0	0.0	0.0	0.0	0.0	0.0
	Pathanamthitta	29.3	37.0	11.2	9.2	8.3	0.0	0.0	0.0	4.9	0.0
	Thiruvananthapuram	36.4	14.1	25.2	8.3	8.5	0.0	7.5	0.0	0.0	0.0
	Thrissur	59.3	24.2	12.4	4.2	0.0	0.0	0.0	0.0	0.0	0.0
	Wayanad	8.5	13.2	28.5	27.1	9.8	7.9	3.6	0.2	1.1	0.0
	All Kerala	15.6	15.6	19.6	16.7	9.9	9.5	5.7	3.1	4.3	0.0
Karnataka											
	Chickmagalur	58.2	26.2	7.6	6.1	2.0	0.0	0.0	0.0	0.0	0.0
	Kodagu	18.4	36.3	12.2	22.5	10.6	0.0	0.0	0.0	0.0	0.0
	All Karnataka	27.5	30.9	13.2	18.1	10.3	0.0	0.0	0.0	0.0	0.0
Tamil Nadu											
	All Tamil Nadu	36.6	26.4	17.4	5.1	1.4	7.5	5.7	0.0	0.0	0.0

Source: SB, ESI-VU, 1997

In Tables 8 and 9 the distribution of pepper vines by variety is shown: in Table 8 the average per household distribution of varieties and in Table 9 the aggregate distribution of varieties on district and state level. Before evaluating the composition by variety we may first make some comments on the average number of vines per farm household on a district level. From Table 8, and focusing on Kerala, it is observed that the average number of vines per household is extremely large in Idukki and Wayanad (respectively 740 and 600 vines per household), while this number is extremely low in Alapuzza, Ernakulam and Thrissur (substantially less than 100 vines per household). However, even if questionable observations are omitted (Shimoga and Coimbatore) the average number of vines per household is much larger in the states Karnataka and Tamil Nadu.

Table 8 District wise distribution of average per household number of vines by variety

		Variety (average per household share of number of vines by district and variety in %)															
	Average number of vines per household	**Kari munda**	**Panni yur**	**Kullu vally**	**Kotta Nadan**	**Balan kotta**	**Vella mundi**	**Chet tan**	**Neela mundi**	**Wyna dan**	**Chenga Nur**	**Jeeraka mundi**	**Arakula munda**	**Naraya kodi**	**Nadan**	**Kuthira vally**	**Other**
Kerala																	
Alappuzha	36	25.0	19.4											5.6	2.8	36.1	11.1
Ernakulam	66	24.2	19.7										4.5		33.3	3.0	15.2
Idukki	738	23.8	8.1	0.4	0.1		13.7		34.4		3.7	4.3			0.4	0.1	10.8
Kannur	153	40.5	20.9	2.6		1.3		5.2					13.7		7.2		8.5
Kasargode	99	29.3	39.4	1.0				1.0					4.0		22.2		3.0
Kollam	172	46.5	14.0		2.3		2.3							1.7	7.0	4.7	21.5
Kottayam	159	50.3	11.3				1.9							22.6	5.7	0.6	7.5
Kozhikode	189	56.1	23.3			3.2		9.0					3.2		4.8		0.5
Malappuram	136	63.2	11.8			8.1		4.4					2.2	5.1	3.7		1.5
Palakkad	200	36.5	28.0			0.5	0.5	0.5					5.0		21.5		7.5
Pathanamthitta	87	26.4	9.2				2.3		1.1					39.1	11.5		10.3
Thiruvananthapuram	97	21.6	12.4		51.5		1.0									1.0	12.4
Thrissur	59	20.3	50.8										3.4		16.9		8.5
Wayanad	602	38.5	30.4	1.2	2.0	3.3	1.3	2.3	0.7	7.8		1.0	0.7		0.2		10.6
All Kerala	260	34.2	18.8	0.8	1.9	1.5	5.4	1.9	12.3	2.3	1.2	1.9	2.3	1.5	3.5	0.4	10.0
Karnataka																	
Chickmagalur	4047	23.7	76.0	0.0													0.2
Dakshina Kannada	279	12.9	87.1														
Hassan	4021	8.6	90.3	1.0													
Kodagu	3655	13.9	84.1	1.7		0.2											0.0
Shimoga	7550	6.6	93.4														
Uttara Kannada	557	15.8	37.0														47.2
All Karnataka	3062	12.1	85.5	0.8		0.1											1.4
Tamil Nadu																	
Coimbatore	23330	5.7	94.3														
Dindigul	1899	31.9	30.0	0.1	33.8	2.5											1.8
Kanyakumari	2078	39.9	44.4							0.2					1.0		14.4
Nilagiri	843	54.3	34.8							8.3							2.6
Salem	11175	34.7	60.0	3.1	2.2												
All Tamil Nadu	2000	34.8	42.4	0.8	17.9	1.3				1.4							1.5

Source: SB, ESI-VU, 1997

Table 9 District wise distribution of total number of pepper vines by variety

		Variety (share of the total number of vines by district and variety in %)															
	Number of vines, district total	**Kari Munda**	**Panni yur**	**Kullu vally**	**Kotta nadan**	**Balan Kotta**	**Vella mundi**	**Chet tan**	**Neela Mundi**	**Wyna dan**	**Chenga Nur**	**Jeeraka mundi**	**Arakula munda**	**Naraya kodi**	**Nadan**	**Kuthira vally**	**Other**
Kerala																	
Alappuzha	707,762	25.8	19.9											5.0	3.4	36.1	9.8
Ernakulam	2,792,748	24.1	19.0								0.5		5.1		34.0	2.3	15.0
Idukki	47,711,452	23.9	8.1	0.4	0.1		13.7		34.5		3.7	4.3			0.4	0.2	10.7
Kannur	16,575,184	40.6	21.2	2.3	0.3	1.3	0.2	4.9		0.1			13.6	0.1	6.9		8.5
Kasargode	2,602,153	29.3	39.5	1.0				1.4		0.2			4.5		22.0		2.1
Kollam	4,846,232	46.6	14.2		2.2		2.3							1.8	7.0	4.5	21.4
Kottayam	4,528,272	50.3	11.5				2.0						0.1	22.5	5.4	0.7	7.5
Kozhikode	5,032,974	55.8	23.1			3.2		8.9		0.1			3.1		4.7		1.1
Malappuram	3,917,734	63.5	12.0			7.8		4.4					2.3	5.4	3.4		1.2
Palakkad	1,871,048	36.3	28.1			0.3	0.3	0.5					4.9		21.7		7.9
Pathanamthitta	2,153,201	26.7	9.2				2.0		0.9					39.7	11.7		9.8
Thiruvananthapuram	2,895,864	22.1	12.7		51.3		1.2								0.4	0.7	11.6
Thrissur	1,314,221	20.9	51.6					0.5					3.1	0.1	17.9	0.2	5.7
Wayanad	39,604,616	38.5	30.4	1.1	1.9	3.3	1.3	2.3	0.6	7.8		0.9	0.6		0.1		11.2
All Kerala	136,553,456	34.4	18.9	0.8	1.8	1.5	5.4	1.8	12.2	2.3	1.3	1.8	2.3	1.6	3.5	0.5	9.9
Karnataka																	
Chickmagalur	6,272,170	23.7	76.0	0.1													0.2
Dakshina Kannada	931,561	12.8	87.2														
Hassan	6,663,130	8.6	90.3	1.0													0.1
Kodagu	19,962,564	13.9	84.2	1.7		0.2											
Shimoga	16,272,890	6.6	93.4														
Uttara Kannada	1,500,242	15.8	37.0														47.2
All Karnataka	51,602,556	12.1	85.6	0.8		0.1											1.4
Tamil Nadu																	
Coimbatore	375,558	5.7	94.3														
Dindigul	2,996,120	31.9	30.0	0.1	33.8	2.5											1.7
Kanyakumari	36,487	40.0	44.4							0.2					1.0		14.4
Nilagiri	998,871	54.3	34.8							8.3							2.6
Salem	1,440,340	34.7	60.0	3.1	2.2												
All Tamil Nadu	5,847,376	34.8	42.4	0.8	17.9	1.3				1.4							1.4

Source: SB, ESI-VU, 1997

As far as the composition by variety is concerned the dominant position of Karimunda and Panniyur as reported in other studies, is clearly confirmed. In the majority of districts around 60% or more is of these two varieties. There are a few exceptions to this pattern. Some other varieties are popular in specific districts: Neelamundi and Vellamundi in Idukki, Kottanadan in Thiruvananthapuram and Dindigul, Wynadan in Wayanad, Chettan in Kozhikode and Malapuram, Balankotta in Malappuram. Narayakodi in Kottayam and Pathanamthitta, Arakulamundi in Kannur and Kuthiravally in Alapuzha. On the whole, other varieties than Karimunda and Panniyur are rarely found in Karnataka and Tamil Nadu, with the notable exception of Wynadan in Nilagiri. The variety Panniyur is very popular in Karnataka (except in Uttara Kannada) with per household shares and aggregate district shares of 75% or higher. The category 'other' appears to be large for the district Uttara Kannada, which is due to the variety Malligesara, and for the district Kollam, which is due to the variety Karuvilanchi.

4 Pepper cultivation: vines by age and aggregate production

In Tables 10 and 11 the distribution of pepper vines by age is shown: in Table 10 the average per household distribution of vines by age and in Table 11 the aggregate distribution of vines by age on district and state level. It should be noted that the age categories comprise a different number of years: the first two categories comprise two years each, the next 4 categories comprise 4 years each, while the last category is unlimited by nature. Such a distinction in age groups is also applied in the questionnaire and is believed to capture both the major features of the age composition of the pepper vines and also respects the boundaries of what reasonably may be asked when interviewing a farmer. From the tables it is observed that pepper vines of 20 years of age or older are rare: only in a few districts, namely Pathanamthitta and Hassan, a substantial number of pepper vines (both average per household as well as per district) fall in this age category. The number of pepper vines of 20 years of age or older is less but still not negligible in a few other districts, namely Idukki, Kannur, Kottayam and Thiruvananthapuram. The occurrence of old age vines is more or less consistent with the age distribution reported in George et al. (1989). On a state level around 90% of the number of vines is less than 15 years of age, both average per household as well as per district. The assertion that one of the main constraints to higher productivity is the preponderance of senile vines (see Sarma et al. (1991)) seems to be rejected by our data[6]. If we control for questionable districts it appears that pepper vines in Karnataka are on average extremely young: in many districts in Karnataka more than 80% is younger than 8 years (compared to less than 60% pepper vines younger than 8 years in both Kerala and Tamil Nadu). The share of vines aged 0 and 1 in Karnataka and Tamil Nadu is on the whole very high. Also the share of vines aged 4-7 is extremely high in Karnataka[7]. Some extreme figures, either low or high, are worth mentioning. Nilagiri has an extremely low number of pepper vines aged 0 and 1. In entire Tamil Nadu, with the exception of Dindigul, the share of vines aged 8-11 is extremely large[8]. The shares of the higher age groups are more difficult to evaluate without knowledge on the incidence of disease.

[6] The age distribution of pepper vines may have been entirely different at the time of their study.
[7] Our benchmark in this respect is a 'normal' investment pattern: seeCheriankunju et al. (1999) for details.
[8] In a number of districts, notably Coimbatoire, the high share is due to only a few observations.

Table 10 Age wise distribution of average number of vines per household, by district

			age in years (% share of row total)						
		Average number of vines per household	**0-1**	**2-3**	**4-7**	**8-11**	**12-15**	**16-19**	**>20**
Kerala									
	Alappuzha	36	16.7	30.6	27.8	19.4	0.0	0.0	5.6
	Ernakulam	66	12.1	9.1	34.8	25.8	10.6	6.1	1.5
	Idukki	738	17.8	16.0	24.3	21.3	12.2	2.8	5.7
	Kannur	153	19.0	17.6	29.4	18.3	7.8	2.0	5.9
	Kasargode	99	14.1	17.2	26.3	25.3	9.1	6.1	3.0
	Kollam	172	14.5	22.1	28.5	26.2	4.7	1.7	2.3
	Kottayam	159	13.8	17.0	19.5	27.7	13.2	3.1	5.0
	Kozhikode	189	12.7	11.6	29.6	29.6	11.6	2.6	2.1
	Malappuram	136	14.7	23.5	39.0	14.7	6.6	0.7	0.0
	Palakkad	200	13.5	24.5	21.5	29.0	8.5	3.0	0.0
	Pathanamthitta	87	16.1	18.4	21.8	25.3	5.7	3.4	9.2
	Thiruvananthapuram	97	12.4	18.6	25.8	21.6	11.3	7.2	4.1
	Thrissur	59	8.5	22.0	28.8	18.6	15.3	1.7	1.7
	Wayanad	602	13.3	11.8	23.9	26.7	14.5	6.5	3.5
	All Kerala	260	15.8	15.4	25.8	23.1	11.5	3.8	4.6
Karnataka									
	Chickmagalur	4047	31.0	15.3	28.2	20.7	3.1	1.0	0.8
	Dakshina Kannada	279	38.1	16.5	18.7	24.8	1.8	0.0	0.0
	Hassan	4021	31.7	26.2	18.2	7.9	2.6	5.7	7.6
	Kodagu	3655	31.4	18.8	20.4	17.5	7.4	3.9	0.6
	Shimoga	7550	13.4	6.6	79.5	0.5	0.0	0.0	0.0
	Uttara Kannada	557	24.7	19.9	37.3	5.0	13.1	0.0	0.0
	All Karnataka	3062	25.7	15.5	40.2	11.0	4.0	2.4	1.3
Tamil Nadu									
	Coimbatore	23330	11.6	6.3	0.0	82.2	0.0	0.0	0.0
	Dindigul	1899	35.0	18.2	15.3	15.5	16.0	0.0	0.0
	Kanyakumari	2078	10.1	7.5	22.0	30.0	30.4	0.0	0.0
	Nilagiri	843	1.5	15.8	17.4	34.5	10.3	19.8	0.6
	Salem	11175	15.5	11.9	27.1	40.8	1.5	1.6	1.6
	All Tamil Nadu	2000	22.9	15.4	17.7	29.4	10.5	3.8	0.5

Source: SB, ESI-VU, 1997

Table 11 Age wise distribution of total number of pepper vines by district

			age in years (% share of row total)						
		Total number of vines	0-1	2-3	4-7	8-11	12-15	16-19	>20
Kerala									
	Alappuzha	707,762	17.7	29.8	26.5	20.2	0.9	0.0	5.0
	Ernakulam	2,792,748	12.2	9.7	34.9	25.1	10.0	6.7	1.3
	Idukki	47,711,452	17.8	15.9	24.3	21.3	12.2	2.8	5.7
	Kannur	16,575,184	19.1	17.6	29.4	18.1	7.8	1.8	6.1
	Kasargode	2,602,153	13.8	17.4	26.3	25.1	8.7	6.0	2.8
	Kollam	4,846,232	14.7	22.0	28.2	26.2	4.7	1.7	2.6
	Kottayam	4,528,272	14.0	17.1	19.5	27.5	13.5	3.1	5.3
	Kozhikode	5,032,974	12.5	11.7	29.4	29.8	11.7	2.9	2.1
	Malappuram	3,917,734	14.8	23.8	39.1	14.5	6.8	1.1	0.0
	Palakkad	1,871,048	13.6	24.6	21.6	28.9	8.4	2.9	0.0
	Pathanamthitta	2,153,201	15.9	18.2	21.7	25.9	6.0	3.3	8.9
	Thiruvananthapuram	2,895,864	12.3	18.0	25.7	21.4	11.4	7.2	3.9
	Thrissur	1,314,221	9.3	23.0	29.5	18.2	16.1	1.6	2.3
	Wayanad	39,604,616	13.3	11.8	24.0	26.7	14.4	6.4	3.4
	All Kerala	136,553,456	15.7	15.5	25.7	23.3	11.6	3.9	4.4
Karnataka									
	Chickmagalur	6,272,170	31.0	15.3	28.2	20.7	3.1	1.0	0.8
	Dakshina Kannada	931,561	38.1	16.6	18.6	24.9	1.9	0.0	0.0
	Hassan	6,663,130	31.7	26.2	18.2	7.9	2.6	5.7	7.6
	Kodagu	19,962,564	31.4	18.8	20.4	17.5	7.4	3.9	0.6
	Shimoga	16,272,890	13.4	6.6	79.5	0.5	0.0	0.0	0.0
	Uttara Kannada	1,500,242	24.8	19.9	37.2	5.0	13.1	0.0	0.0
	All Karnataka	51,602,556	25.7	15.5	40.1	11.0	4.0	2.4	1.3
Tamil Nadu									
	Coimbatore	375,558	11.6	6.3	0.0	82.2	0.0	0.0	0.0
	Dindigul	2,996,120	35.0	18.2	15.3	15.5	16.0	0.0	0.0
	Kanyakumari	36,487	10.1	7.5	22.0	30.0	30.4	0.0	0.0
	Nilagiri	998,871	1.6	15.7	17.4	34.5	10.4	19.8	0.6
	Salem	1,440,340	15.5	11.9	27.1	40.8	1.5	1.6	1.6
	All Tamil Nadu	5,847,376	22.8	15.4	17.6	29.3	10.5	3.8	0.5

Source: SB, ESI-VU, 1997

Table 12 shows the production estimates for different states and districts. The method of calculation of production is closely linked to the sample design, which is set out in the appendix. The estimates show a decline in Kerala from 66 thousand tonnes in 1995-96, to 54 thousand tonnes in 1996-97 and 47 thousand tonnes in 1997-98. It should be noted, however, that the estimate for 1997-98 represents expected production and is not comparable with the estimates for 1995-96 and 1996-97. A correction of the 1997-98 estimate, based on realisations, will be reported in a revised version of this study. Preliminary work in this respect indicates that actual 1997-98 production is substantially higher than 47 thousand tonnes. Production in Karnataka reaches a high of 20 thousand tonnes in 1997-98, while production in Tamil Nadu remains on a relatively modest level of 3 thousand tonnes.

It is difficult to compare these estimates with other figures: after all, with a lack of reliable production estimates for pepper in India, estimations of production is the very reason for doing

this research. Nevertheless, the presented estimates seem reasonable for Kerala if compared with both official and traders estimates: DES estimates for Kerala are, for 1995-96s: 68574 tonnes and for 1996-97: 56574 tonnes. The estimates for Karnataka, especially for 1997-98, appear on the high side. Possibly this is caused by selection bias in the sample of farmers in Karnataka (see the appendix).

Table 12 Production of pepper in tonnes, by district and state

	District	95-96	96-97	97-98 (expected)	97-98 (expected,corr)
Kerala					
	Alappuzha	234	198	212	
	Ernakulam	1498	1531	1372	
	Idukki	18655	17040	14648	
	Kannur	5702	5422	5637	
	Kasargode	1370	1323	995	
	Kollam	1976	2086	2020	
	Kottayam	1512	1402	1416	
	Kozhikode	3025	2396	1955	
	Malappuram	2100	1730	1523	
	Palakkad	1333	985	762	
	Pathanamthitta	844	819	745	
	Thiruvananthapuram	1034	941	946	
	Thrissur	495	380	453	
	Wayanad	26646	17582	14264	
	All Kerala	66424	53835	46948	
Karnataka					
	Chickmagalur	1611	1862	2438	
	Dakshina Kannada	464	491	298	
	Hassan	1801	2384	2288	
	Kodagu	11922	10071	9083	
	Shimoga	1983	2522	5205	
	Uttara Kannada	348	405	464	
	All Karnataka	18129	17735	19776	
Tamil Nadu					
	Coimbatore	8	8	6	
	Dindigul	1435	1865	1536	
	Kanyakumari	22	22	23	
	Nilagiri	1073	1200	1124	
	Salem	271	340	238	
	All Tamil Nadu	2810	3435	2927	
All India		87362	75005	69651	

Source: SB, ESI-VU, 1997

The distribution of vines by age is particularly interesting as it allows estimating the contribution of each age group to the aggregate production of a household. More specifically, harvest per household is equal to the sum of number of (bearing) vines per age group times the yield per (bearing) vine[9] for each age group, or formally:

[9] The concept 'vine' as used in this study is to be interpreted as 'stand' and actually may comprise several plants.

$$hrv(i) = \sum_{j=0}^{\infty} nv(i,j) * yld(j) \qquad (1)$$

where

$hrv(i) = harvest\ of\ household\ i$
$nv(i,j) = number\ of\ vines\ of\ age\ j\ in\ household\ i$
$yld(j) = yield\ per\ vine\ of\ age\ j$

This relationship is estimated with simple linear regression. Before bearing any fruit, pepper vines have a substantial non-bearing stage. The duration of the non bearing period is probably around four years on average, but there could be differences (see George (1989), p. 10). However, with a relatively high degree of certainty it may be stated that vines with an age of 0 or 1 do not bear fruit. Hence, vines of age 0-1 are not included in the regression as these vines are presumed to be non-bearing[10]. Also very old aged vines (older than 20 years), are assumed to yield negligible output and hence in the estimations the yield of these vines is restricted to zero. Controlling for variety or for any other variable is not implemented: some results of more elaborate estimations are reported in Cheriankunju, Jagadeesan, Sreekumar and Zant (1999). An selection of estimation results[11] of the above equation is reported in Table 13.

From the table it is observed that the coefficients of the estimated equations are, almost without exception, statistically significant. The actual values of the coefficients – the yield per vine by age - are in most cases of a fairly sensible size, ranging from negligible to slightly above 1000 grams per vine. The annual reports of the Directorate of Cocoa, Arecanut & Spices Development Ministry of Agriculture, Government of India mention comparable yields per standard[12]. Systematic patterns are observed in some cases, but also rather erratic patterns are seen. More elaborate estimations are required to derive systematic development of yield over time. Such estimations may control for a range of variables, make appropriate selections of the applied data and impose a specific structure of the development of yield over time. As mentioned above, an attempt in this direction is reported in elsewhere.

Table 13 Estimation of production (in kg.) on number of vines by age (equation 1) *

		age of vines
District	**# of**	

[10] This is corroborated by a study from the Central Plantation Crops Research Institute (1985).
[11] Estimation results have been selected on the basis of economic plausibility: negative values of the coefficients (i.e. yields) and extremely large values are considered implausible and due to too few observations for specific age groups. Also goodness of fit criteria are used in selecting the equations in the table.
[12] Averaged over the years 88/89 to 96/97 the Directorate of Cocoa,Arecanut & Spices Development reports the following yields per vine: Ernakulam 0.598 (0.581); Idukki 0.712 (0.739); Kannur 0.523 (0.630); Kasargod 0.625 (0.745); Kollam 0.912 (0.668); Kottayam 0.628 (0.541); Kohikode 0.641 (0.753); Pathanamthitta 0.790 (0.547); Thiruvananthapuram 0.664 (0.529); Wayanad 1.120 (0.721). In brackets the yield per vine according to our survey data is shown.

	observations	2-3	4-7	8-11	12-15	16-19	>20	adj.R2
Alappuzha	19		0.8	0.6	1.7			0.87
			(7.0)	(7.8)	(1.8)			
Ernakulam	63		0.61	0.48	1.07	0.08		0.72
			(6.8)	(4.3)	(5.2)	(0.5)		
Idukki	525		0.42	0.39	0.68	0.76	0.44	0.57
			(10.1)	(7.2)	(10.6)	(3.8)	(3.4)	
Kannur	358		0.52	0.48	0.68	0.07	0.33	0.66
			(12.4)	(8.2)	(9.7)	(0.4)	(3.7)	
Kasargode	73		1.19	0.55	0.45	1.07	0.61	0.66
			(5.5)	(3.7)	(1.5)	(2.6)	(1.1)	
Kollam	100		0.39	1.26	0.42	0.17		0.76
			(3.5)	(11.5)	(0.7)	(0.2)		
Kottayam	103		0.57	0.31	0.27	0.85	0.76	0.81
			(7.9)	(4.8)	(4.3)	(4.4)	(5.2)	
Kozhikode	153		0.69	0.37	0.05	0.36	1.48	0.66
			(6.9)	(4.3)	(0.4)	(0.9)	(2.3)	
Pathanamthitta	57	0.29	0.54	0.45	1.32	0.29	0.42	0.81
		(1.5)	(4.5)	(4.5)	(7.6)	(0.8)	(2.1)	
Thiruvananthapuram	67	0.70	0.03	0.40	0.52	0.26		0.75
		(4.0)	(0.4)	(4.7)	(3.3)	(2.7)		
Wayanad	460	0.46	0.44	0.39	0.46	0.36	0.65	0.84
		(6.0)	(9.2)	(8.9)	(7.5)	(4.2)	(5.0)	

Source: SB, ESI-VU, 1997

* t-statistics are reported below the coefficient in between brackets; adjR2= coefficient of correlation adjusted for degrees of freedom

Figure 2 Yield per vine over age

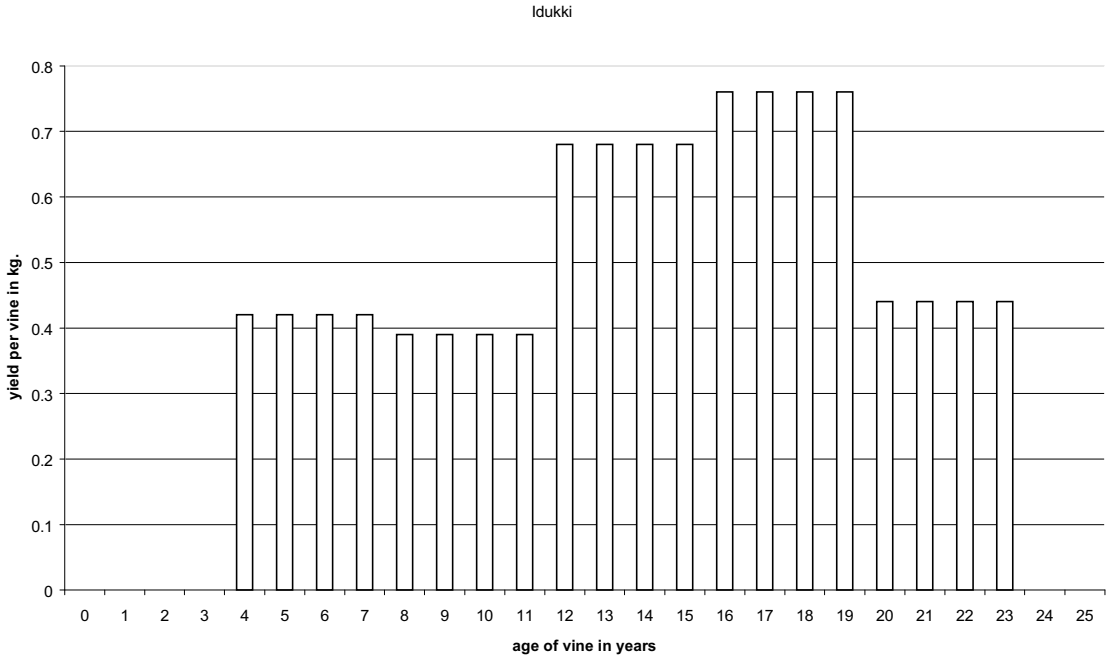
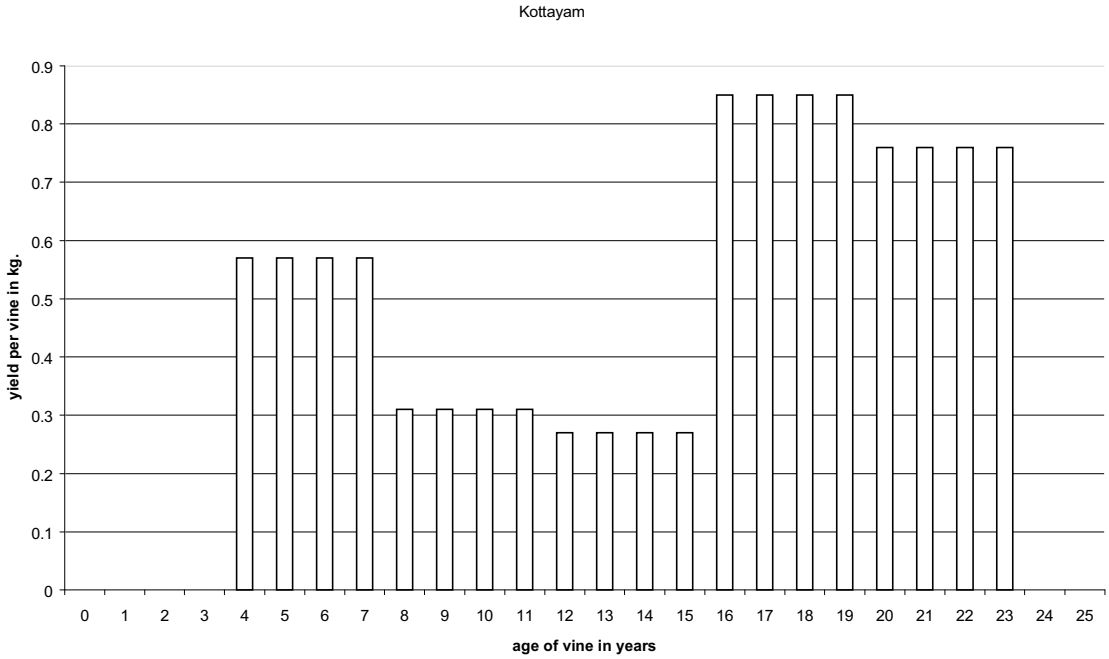


Figure 3 Yield per vine over age



5 Pepper cultivation: realised and planned uprooting of vines

In order to understand the dynamics of pepper cultivation – the development of the number of vines over time - it is interesting to consider uprooting of plots, both in terms of its relative importance (number of plants and area) as well as in terms of its driving forces, and both realised as well as planned. Table 14 reports the number of observations with positive uprooting by reason of uprooting for the crop years 1994-95, 1995-96 and 1996-97, by type of crop uprooted, and expressed as a percentage of the column total. From the table it is immediately obvious that the major reason for uprooting plots with pepper vines is the incidence of diseases: in all years this reason for uprooting pepper plots accounts for more tha 95% of all uprooting. It also seems that the incidence of diseases in other crops is less than in pepper cultivation, although this may be due to selection bias (note that there are only pepper farmers in the sample). The picture that emerges is to some extent confirmed in George et al. (1989): for a specific year (1985) they also report a substantial incidence of disease which comes in the range of our estimates. However, their information also indicates a high incidence of drought, which could not be identified in our data. Their data also make clear that the incidence of diseases is substantially less when droughts have a major impact on the pepper vines, which is not surprising as diseases are strongly related to rainfall and humidity (see e.g. Balakrishnan et al. (1986), p17; Ramachandran et al. (1988)). It should be noted that the lack of incidence of drought on pepper vines in our data set might entail a bias in the analysis.

Table 14 Realised uprooting of crops by reason, type of crop and year *

Crop year	Reason	Pepper	Other crops	Total
1994-95	Incidence of diseases or drought	95.0	78.6	89.1
	Other reasons	5.0	21.4	10.9
	Total	100	100	100
1995-96	Incidence of diseases or drought	95.8	50.2	86.6
	Other reasons	4.2	49.8	13.4
	Total	100	100	100
1996-97	Incidence of diseases or drought	95.0	45.4	83.6
	Other reasons	5.0	54.6	16.4
	Total	100	100	100

Source: SB, ESI-VU, 1997

* The table reports the column share in % of number of observations with positive uprooting and distinguishes these numbers by year of uprooting, by type of crop uprooted and by reason of uprooting.

There also seems to be substantial regional variation in the incidence of diseases. Table 15 summarises the uprooting of vines by district. Combined with the information of Table 14, the evidence in Table 15 may also be interpreted as a reflection of the geographic distribution of the incidence of diseases. For the crop years 1994, 1995 and 1996 the table reports the share of vines uprooted relative to the total number of vines in the district. The aggregate number of vines on district level is available for the crop year 1994-95, 1995-96 and 1996-97 for Kerala. For Karnataka and Tamil Nadu these aggregates are calculated on the basis of the sample.

Table 15 Uprooting of vines by district and year

	share of uprooted vines in % of total number of vines			
	crop year			
district	**94-95**	**95-96**	**96-97**	**94-97(avg)**
Kerala				
Alappuzha	0.0	0.0	0.0	0.0
Ernakulam	4.5	9.0	7.5	7.0
Idukki	3.8	1.9	0.8	2.2
Kannur	5.2	5.4	6.0	5.5
Kasargod	15.0	15.1	15.5	15.2
Kollam	0.0	0.0	0.0	0.0
Kottayam	0.6	0.0	0.0	0.2
Kozhikode	17.8	12.2	6.0	12.0
Malappuram	7.1	13.7	11.3	10.7
Palakkad	5.3	22.9	12.2	13.5
Pathanamthitta	0.2	0.0	0.0	0.1
Thiruvananthapuram	0.0	0.0	0.0	0.0
Thrissur	6.2	5.9	6.9	6.3
Wynad	12.1	11.4	2.2	8.5
All Kerala	7.2	6.6	3.0	5.6
Karnataka				
Chickmagalur	0.0	0.0	0.0	0.0
Dakshina Kannada	0.0	0.0	0.0	0.0
Hassan	0.0	0.0	0.0	0.0
Kodagu	0.0	0.5	0.0	0.2
Shimoga	0.0	0.0	0.0	0.0
Uttara Kannada	0.0	0.0	0.0	0.0
All Karnataka	0.0	0.2	0.0	0.1
Tamil Nadu				
Coimbatore	0.0	0.0	0.0	0.0
Dindigul	0.0	0.1	0.6	0.2
Kanyakumari	0.0	0.0	0.0	0.0
Nilagiri	0.0	0.2	3.6	1.3
Salem	0.0	0.0	0.0	0.0
All Tamilnadu	0.0	0.1	0.9	0.3

Source: SB, ESI-VU, 1997

From the table it is observed that uprooting of vines is distributed unevenly over the districts: in some districts uprooting is zero or marginal for all the three years, while in others it is substantial or even dramatic. Also uprooting of vines is shown to vary substantially both over the years and between districts: both Karnataka and Tamil Nadu districts show negligible or low levels of uprooting, for all three years. For Kerala a number of districts may be identified with low levels of uprooting (Alapuzha, Idukki, Kollam, Kottayam, Pathanamthitta, Thiruvananthapuram), some with medium levels of uprooting (Ernakulam, Kannur, Thrissur and Wayanad), and some have high levels of uprooting (Kasargod, Kozhicode, Malapuram and Palakkad). During the crop year 1994-95 and 1995-96 the level of uprooting in Kerala is on average more than twice as high as compared to the crop year 1996-97. Also apparent from the table is the large extent of uprooting in a few specific districts and years, for example

Kozhikode in 1994-95, and Palakkad in 1995-96: as much as around one-fifth of the total number of vines is uprooted in one year! If the evidence in Table 15 is interpreted as a reflection of the district-wise distribution of the incidence of diseases, it is clear that most vines will be affected by disease long before they have a chance to become senile and unproductive. Finally, if we focus on the most important districts for pepper cultivation we observe that level of uprooting in Wayanad is two to three times as high as in Idukki.

Other evidence also supports regional variation in the incidence of diseases (see e.g. Mammooty et al. (1988)), Table VII), but we were unable to obtain comprehensive information for Kerala, Karnataka and Tamil Nadu indicating systematic regional patterns of incidence. The circumstances in pepper cultivation (c.q. natural environment, rainfall and humidity, density in cultivation, crop combination, elevation) in some parts of the country may cause a larger / smaller damage by diseases in pepper cultivation than other parts and, hence, may have a systematically different incidence. More information is needed to elaborate this point. Other evidence also indicates some variation of incidence of disease by variety of pepper (see e.g. Mammooty et al. (1988)), Table VIII): these sources report, however, that the major varieties have remarkably similar incidence rates. The crop combination is perhaps a major determinant of the incidence of disease: some authors (see Sarma et al. (1991)) suggest a minimum incidence of foot rot in coffee-pepper mixed cropping systems, a combination that is particularly popular in Karnataka and Tamil Nadu (see also Section 2). It appears from the data that diseases do not specifically affect old aged vines[13]. The 'All Kerala' incidence is substantially larger in 1994-95 and 1995-96, compared to 1996-97. The figures are in the range of incidence rates reported elsewhere (see Balakrishnan et al. (1986), p. 27: they report a loss of 11% of vines during a period of three years, namely 1982 to 1984).

Table 16 summarises the information on how many uprooted pepper plots have been converted into cultivation of a different crop and vice versa. The table suggests a rather stable pattern: if all uprooting is considered (which includes not only observations with uprooting of pepper vines), in between 85% and 92% of the observations reporting uprooting, pepper is planted as the new crop. In between 66% and 80% of all pepper vines that are uprooted, pepper is again planted after uprooting. Obviously, these two percentages are to a large extent overlapping. A substantial number of cases the uprooted plot is left without a crop (and perhaps planted with pepper vines in a subsequent year), which may have to do with diseases and pests: The soil may require some period for recovering from these diseases.

Table 16 Uprooting: moving in and out of pepper cultivation

		From which crop to pepper cultivation		**From pepper cultivation to which crop**
Crop year		**Share in %**		**Share in %**
94 (94-95)	Pepper	83.3	Pepper	67.9

[13] With our data set it is, unfortunately, not possible to extract information on the age of vines when uprooted because of diseases, simply because the age at uprooting is not reported. The age composition of vines of each household that reports incidence of disease may serve as an approximate indication of the age distribution of vines that are uprooted due to diseases.

	Other crops	16.7	Other crops	32.1
	Total	100.0	Total	100.0
95 (95-96)	Pepper	91.6	Pepper	69.5
	Other crops	8.4	Other crops	30.5
	Total	100.0	Total	100.0
96 (96-97)	Pepper	90.2	Pepper	84.2
	Other crops	9.8	Other crops	15.8
	Total	100.0	Total	100.0

Source: SB, ESI-VU, 1997

Table 17 shows the number of observations in the sample that report uprooting plans by crop and by reasons for uprooting: the table expresses this number as a share of the column total and highlights the importance of different reasons for uprooting for specified crops. The larger part of uprooting plans concerns uprooting of pepper (57.9% of all observations) which is not a surprise with our sample of pepper farmers, but also a substantial number of observations concerns uprooting plans for cardamom (14.0%). The last column of the table, the 'total' column, indicates that the larger part of uprooting is caused by diseases, irrespective of the crop under consideration. The incidence of disease is, apparently, and to some extent known in advance. In the case of pepper an even larger share of uprooting plans is due to diseases (80.8%). Rising prices of other crops combined with old standing crop account for the major reason of plans to uproot of natural rubber and coffee. In the case of cardamom the declining price of the current crop and the rising price of alternative crops explains the uprooting plans in slightly more than 50% of all farmers that plan uprooting of cardamom.

Table 17 Planned uprooting of plots by reason and crop (in % of column total) *

reason	**pepper**	**coffee**	**carda-mom**	**coco-nut**	**areca-nut**	**natural rubber**	**other**	**total**
declining price current crop	0.4	0.0	31.3	0.0	0.0	11.5	3.7	5.8
rising price alternative crop	11.7	33.2	16.7	6.3	0.0	40.6	38.3	17.2
old standing crop	5.0	40.6	4.6	0.0	8.7	23.5	13.8	8.5
increase in labour costs	0.5	0.0	8.3	47.4	0.0	0.0	0.0	2.9
increase in material costs	0.0	0.0	2.8	0.0	0.0	0.0	1.8	0.6
incidence of disease or drought	80.8	10.1	32.4	46.3	91.3	13.1	23.6	60.3
other	1.7	16.1	3.9	0.0	0.0	11.3	18.8	4.7
total	100	100	100	100	100	100	100	100

Source: SB, ESI-VU, 1997

* The table reports the column share in % of number of observations with positive planned uprooting and distinguishes these numbers by type of crop uprooted and by reason of uprooting.

Appendix A: Creating a Sample Design and Estimating Area

1 Introduction

The purpose of this appendix is to explain the sample design for the survey among pepper farmers. The territorial spread of the field investigation is confined to three pepper producing states viz., Kerala, Tamil Nadu and Karnataka. Kerala accounts for more than 90% of the total area under pepper according to the official statistics. For this reason most surveys in the past have focussed on Kerala. No surveys on pepper cultivation in Karnataka or Tamil Nadu are known. In this appendix the same distinction is made: the sample design for Kerala is treated separately from the sample design for Karnataka and Tamil Nadu. Evaluation of other surveys is restricted to surveys on Kerala.

A number of requirements for the sample design may be identified. The sample design is required to be statistically acceptable, allow a sufficient degree of comparison with officially published statistics and should be considered an improvement, or at least not a deterioration, relative to other designs. As a first step the existing material is reviewed in Section 2: in particular this refers to the sample design developed by the Department of Economics and Statistics in Trivandrum (in the remainder referred to as DES). Also the information on pepper growers available at the Spices Board is considered. After this part, the usefulness of the existing designs and sources of names are assessed for the purpose of our research in Section 3. Then the complete sample design for this study is set out in Section 4. In a final section an attempt is made to construct a meaningful concept for area under pepper cultivation, that is closely related to the actual area allocated to pepper.

2 Existing sample designs and listings of names of farmers

From the descriptive tables in this study we already have observed that pepper is cultivated in all districts of Kerala, even though the intensity varies significantly. Hence, it will be appropriate to cover all districts for the survey. According to the Draft Report on the Baseline Survey for Spices in Kerala (1987) there are about 250,000 farm households in Kerala engaged with pepper cultivation. In a report by the Indian Institute of Foreign Trade in 1988 it is also indicated that there are around 0.25 million farm households where pepper is cultivated. More recently, an estimate of half a million smallholders has been mentioned in an UNCTAD publication (see UNCTAD, 1995, p.9). Neither of these sources, however, have obtained these number through complete enumeration, let alone that there is available a size wise distribution of cultivable area of these households.

There are two sources for sample frames of pepper farmers in Kerala, the first source originates from the Department of Economics and Statistics in Trivandrum (DES), the second from Krishi Bhavan (KB). The survey implemented by DES and supported by EARAS[14] is intended to cover cultivation of all crops and not only cultivation of pepper. The methodology as far as pepper is concerned is split up in the estimation of area and the estimation of production.

In the DES methodology estimation of area under pepper cultivation is set up as follows: state and district is divided in blocks, and the block level is a separate stratum of the survey. It is also

[14] EARAS refers to the scheme for the Establishment of an Agency for Reporting Agricultural Statistics

the level of data that is published and freely available. The blocks are divided into a number of investigator zones. The state in total is divided into 14 districts, 152 blocks (excluding a number of municipalities and corporations[15]) and 811 investigator zones. In each investigator zone 100 clusters of five survey subdivisions are selected for the survey (as in the Basic Tax Register). These clusters are allocated among dry and wet lands in proportion to the area of these categories in the zone. Investigators will count the number of pepper vines in the selected cluster in a zone and record it along with data of other perennial crops. The area under pepper in each zone is then calculated by using a fixed stand per ha (1000 stands per ha in Idukki and Wayanad and 560 in other districts), and then inflating the resultant area with a factor that is equal to the total area in the zone divided by the area selected in the zone. The area under pepper in the block is simply the sum of all zones in the block. Likewise, aggregates could be constructed on taluk, district and state level.

Formally the DES estimation of area runs as follows:

$$A_p(z) = (nv(z)/\delta) \,.\, (A(z)/a(z))$$

where

$A_p(z) = area\ under\ pepper\ in\ zone\ z$;

$nv(z) = number\ of\ vines\ in\ zone\ z\ according\ to\ the\ sample$;

$\delta = standard\ density$;

$A(z) = actual\ area\ in\ zone\ z$;

$a(z) = area\ in\ zone\ z\ according\ to\ the\ sample$;

Similarly, an estimate of the number of vines is obtained as:

$$NV(z) = nv(z) \,.\, (A(z)/a(z))$$

where

$NV(z) = number\ of\ vines\ in\ zone\ z$;

Estimation of production according to the DES methodology is set up as follows: production/yield is estimated by means of a crop cutting experiment. In each zone 2 plots are selected using simple random sampling, and on these plots 5 bearing pepper vines are selected, also using simple random sampling. During harvest the yield of these selected vines (which are given identification marks) is recorded. On the basis of these recording average production per vine in the block is calculated and with these block-wise data on vines an estimate of aggregate production is constructed by summing over blocks. Again and likewise, aggregates could be constructed on taluk, district and state level.

Formally the estimation of production runs as follows.

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in Kerala.

[15] On the block level a number of municipalities (37) and corporations (3, namely,Trivandrum, Calicut and Cochin) are distinguished.

$$Q(b) = \overline{yld}(b_{cce}) \,.\, NV(b)$$

$$\overline{yld}(b_{cce}) = \frac{1}{NZ(b)} . \sum_{z} [\frac{1}{5} . \sum hrv(z,b)]$$

where

$Q(b)$ = *production of pepper in block b*;

$\overline{yld}(b_{cce})$ = *average yield per vine in block b based on crop cutting* exp*eriment*;

$NV(b)$ = *number of vines in block b*;

$NZ(b)$ = *number of zones in block b*;

$hrv(z,b)$ = *harvest of* 5 *selected vines in zone z in block b*

From the above it is observed that the DES data contain a list of randomly chosen farmers, whose plots were selected for the pepper crop cuttings. There are at most 2 x 811 (2 per Investigator Zone) of these farmers in a year. The other source of names and addresses of pepper farmers are from the Krishi Bhavans of the respective places. These listings, however, do not constitute a complete coverage of the total number of pepper farmers in the region. In selecting names from this source there is a danger of an endogenous selection bias in this list, as these farmers may belong to a special group of farmers (e.g. larger, younger, better educated, more accessible farmers, rather than those that have only a home plot, read no newspaper, etc.). A comparison between the farmers taken from DES with those of the KB could possibly shed light on the characteristics of the two groups.

3 Assessing existing designs

The question addressed in this section is which information, reviewed in section 2, is useful for our purpose and which information is not. The advantage of the list of names from the DES survey is its randomness. This is a very important issue. The second advantage is the link that can be established between what the crop cutting has shown and what we arrive at, based on the farmers' own reporting. In this respect it would be important to know when (exactly) the crop was measured on these plots.

Disadvantages are:

- possibly insufficient number of farm-households in the sample if no earlier years are available;
- lack of proportionality: in pepper-intensive areas no more farmers are included than in extensive growing areas. Unless this can be remedied by more names (when more years are available) we must accommodate by re-weighing or by using other sources of names;
- statistical base is the plot, not the farmer. This makes the probability of including a large farmer greater than that of a small farmer. Solution is to weigh the results by the inverse of the number of plots (= survey sub division).

The counting of the number of vines in the DES survey and the subsequent estimate of the number of vines in the block are procedures that cannot be improved upon: there is no reason to assume that estimates of the number of vines are unreliable. However, the conversion from vines to area is questionable. Area estimates of the DES survey are based on counts of standards

on 500 plots in each zone. Area is then calculated by using two fixed values for stand per ha. (560 in all districts except Wayanad and Idukki where it is 1000 per ha.). Such a choice is rather arbitrary as is also understood from the Department of Economics and Statistics in Trivandrum itself. In fact, DES suggest that this should be improved in the future; additionally they underline the limits of the survey by pointing at the cultivation in forest area and the (thousands of acres of) encroached forest land that is not covered in their survey.

In summary, the documentation of the DES sampling procedure suggests that it is difficult to improve upon their estimation of the number of pepper vines in the traditional areas. Their estimate of yield, on the other hand, may suffer from sampling error.

Are there possibilities to realise improvements of the DES methodology? There may be scope for improvement in the estimate of the number of vines relative to the DES survey by focusing on pepper cultivation in non-traditional areas like the encroachments in forest areas, and on pepper cultivation in the states of Karnataka and Tamil Nadu. Improvement of the estimation of area seems possible given the arbitrary method applied in the DES design and by using the strategies suggested below. On the basis of our survey and sample design, estimates of production could also be improved by attempting a more adequate approach with respect to homestead production. Improvement is also possible by securing 'correct' answers from the farmers that are interviewed. The possibilities to achieve this are closely related to the introduction of the purpose of the survey by the interviewer to the interviewed farmer, and the type of questions in the questionnaire (see appendix 2 for the complete questionnaire).

4 A sample design for pepper cultivation in India

A total number of around 2500 farm households is selected for the survey: this amounts to 1% of the (conservative) estimate of the total number of pepper farmers in India. The number has been distributed more or less proportionately to the area and production over the states: 2300 farm households in Kerala, 150 in Karnataka and 50 in Tamil Nadu.

4.1 Constructing sample weights for Kerala

With respect to Kerala it seems most attractive to get as many names from DES as possible: the main reason is the randomness of this list of farmers. After using the DES list, the listing from KB can be used if needed. Initially, it turned out to be possible to get names on the basis of three years, namely the years 1993, 1994 and 1995, yielding a gross number of around 4,700 names of farmers. This seemed to provide a sufficient basis even after adjustment for attrition. Such a large number of names of farmers allows us to sample more farmers in the core areas than in the more peripheral regions. However, as it happened, not all households have been taken from the DES list. Many farmers on the DES list moved to other places, stopped cultivating pepper or died. Also a large number of addresses appeared difficult to find. The construction of the list of names originated 10 years back, at the start of the eighties, and has not been updated since that date. If not sufficient addresses of the DES list could be traced, a substitute has been selected randomly from the Krishi Bhavan list of names. Eventually, the final list of names for the Kerala part of the survey had the following composition: 284 from DES and 2001 from Krishi Bhavan. With such large numbers of names selected through the Spices Board from the Krishi Bhavan list, the representativity of the sample is less obvious, as elements of self selection may have crept into the procedure[16].

The basic approach to weigh the observations in the sample is as follows. As the Department of Economics and Statistics (DES) had a procedure for establishing the number of vines, that could not be improved, the DES projection of the number of vines has been used as a basis for weighing the sample observations, and the sample has been used to assess the production per vine. The approach used by DES and set out above, amounts to counting the number of vines on a random selection of some 500 plots in each Investigator Zone There are 811 of such zones in the State, so that the statistical basis for the assessment of the number of vines is better than can be achieved with any selection of 2500 households. DES reports the numbers implicitly, by stating what area of pepper is cultivated in each block. These areas can be converted into number of standards by multiplying the hectare data by 1000 for Idukki and Wynad, and by 560 elsewhere, or in formula.

$$NV(b) = A_p(b)^* \,.\, \delta$$

$$\text{where } A_p(b)^* = \text{area cultivated with pepper by block as published by DES}$$

[16] When only part of the data stem from households that are selected by DES, the first question is, whether these households show any systematic bias. This can be investigated by looking at the characteristics of these households compared to the DES sub-sample of households. If differences are clear, we do not have an immediate remedy. For this, we need to have data on (a representative sample) the whole population. Only this would permit us to relate the probability for any household to be in the non-DES sample to any of its characteristics. For example, it might be that the larger households are over - represented. This can be adjusted if we would know how many households are in what size class. Only then can we adjust the weights attached to these households. An ideal procedure would be to compare the frequency distributions of the households in the DES sample, in the Krishi Bavan sample for each of the characteristics that are known for each household. Then determine the weights for the non-DES households such that it adjusts for any over- or under-representation. This is, however, not possible given the number of households obtained from DES.

Thus, the sample is not needed for a basis of the quantity of standards, but is useful as a basis for the production. The appropriate weights required to arrive at block-wise aggregates are now easily calculated as the number of vines in the block, as calculated on the basis of the DES data, divided by the number of vines in the block on the basis of our sample, or, in formula:

$$w(h,b) = NV(b) / nv(b)$$
$$where$$
$$w(h,b) = weight\ attached\ to\ household\ h\ in\ the\ sample\ in\ block\ b$$

In this way our design makes use of the good part of the DES design, yet allows to improve on estimates production and area: in particular it saves the randomness of the sample design, making use of the appropriate weights, and at the same time avoids the arbitrary choices made by DES in obtaining area estimates; also production estimates through direct observation (our survey) should give better estimates than their crop cutting method.

In the estimation of production the DES approach has some disadvantages, because the harvest of only at most 8110 standards is measured and the sample variance is therefore rather large. In our sample, we have production data (but less accurately measured) for 2500 households, and implicitly for more than 2.5 million vines in Kerala. Hence, our estimate for production per vine may be more accurate. In addition, the conversion of standards into area need not be as systematic as done by DES, but can take into account the regional diversity as found in the sample. An attempt in this direction is elaborated in Section 5 of this appendix.

In the distribution of addresses over districts and blocks an attempt at proportionality is made. The number of households with pepper cultivation that is covered in each district is determined by the proportion of the pepper area in the district relative to the total pepper area in the state. Likewise, the number of households in each block is determined by the pepper area in the block relative to the total pepper area in the district. This is only a rough procedure to realise some extent of proportional representation of area cultivated with pepper: The very data used to calculate this proportional representation, the official data, are questioned. The available pepper farmers from DES are allocated to these districts. The list of names from Krishi Bhavan are used supplementary to the DES pepper farmers, to the extent that is needed to obtain the required numbers of farmers per district. For each district the selection of these supplementary names is implemented randomly on the basis of a listing. Such a procedure avoids possible bias with respect to the size of farm households. An overview of the number of households selected in each district is presented below, as well as the distribution of these names by source and district.

Table A1 Number of farmers by district in the sample in Kerala

District	Area under pepper	Number of farmers	DES	KB

	(ha.)	surveyed		
Alappuzha	2008	26	2	24
Ernakulam	6799	68	59	9
Idukki	42858	554	34	520
Kannur	32616	394	109	285
Kasargod	7432	75	40	35
Kollam	8221	103	3	100
Kottayam	8753	107	0	107
Kozhikode	12640	158	0	158
Malappuram	8494	104	0	104
Palakkad	3188	43	0	43
Pathanamthitta	4719	62	7	55
Thiruvananthapuram	5021	71	17	54
Thrissur	4985	48	17	31
Wayanad	39814	486	0	486
Total Kerala	187548	2299	288	2011

Source: DES 94/95

Unlike the improvements that we claim in the estimation of production and area, a number of problems in the sample design remained. The first problem pertains to the level of aggregation of publicly available data. Block level data is the lowest level of data that is published and freely available: the sample design from DES is based on zone level information, a subdivision of blocks. This may entail approximations in our design that decreases the statistical quality of our estimates. In the second place it should be noted that the weights are constructed on the basis of DES data from the crop year 1996/97 instead of the crop year 1997/98, the year in which our survey is implemented. These DES data happen to be the latest data that are available. Finally, in our survey only relatively few names have been selected from DES, and relatively many from Krishi Bhavan. This entails a possible selection bias and, hence, may weaken the statistical quality of our approach. Closer co-operation with Department of Economic and Statistics in Trivandrum may resolve these issues in future research.

4.2 Constructing sample weights for Karnataka and Tamil Nadu

As per the official statistics available from the Department of Economics and Statistics in New Delhi, the states of Karnataka and Tamil Nadu contribute only 3% of the total area and production of pepper in India. According to the above source, the total area under pepper in these two states during 1995-96 is 6840 hectares and production is 1,580 tonnes. However, other sources indicate that the area and production of pepper in these two states are higher.

The figures released by the Department of Economics and Statistics, New Delhi show that the area under pepper in Karnataka during 1995-96 is 3630 hectares and the production 910 tonnes. However, the trade sources indicate that the production in Karnataka is much higher than this. They estimate the production around 15,000-20,000 tonnes. The Department of Horticulture in Karnataka published the area under pepper for 1993-94 as 8104 hectares with a production of 21,880 tonnes. They have given the district-wise break-up for the area also. However, they have not given the district-wise break up of production in the state. It is also understood that in almost all the coffee estates in Karnataka, pepper is grown as an intercrop. These leads to the conclusion that the area and production estimated by the Department of Economics and Statistics is very much on the low side. Hence, for the distribution of farmers by

district, to be selected for the sample, it is proposed to use the area and production figures reported by the Department of Horticulture, Karnataka.

With respect to Karnataka there is no list of pepper growers. Since pepper in Karnataka is mainly cultivated as an intercrop with coffee, most of the coffee growers are likely to be pepper growers also. Therefore a random sample of farmers can be obtained from the regional office of the Coffee Board. Names of farmers can be taken from this list randomly up to the point where a total amount of 150 pepper farmers is obtained. As per the figures released by the Horticulture Department, the districts Kodagu, Chickmangalore, Shimoga, Hassan and Dakshina Kannada constitute 98% of the area cultivated under pepper. These districts are classified under two groups. The first group consists of Kodagu, Chickmangalore and Hassan where coffee is the main cultivation. In almost all the coffee estates in these districts, pepper is cultivated as an intercrop. The second group consists of the districts Dakshina Kannada, Shimoga and Uttara Kannada. These districts are important for arecanut cultivation. Pepper is cultivated as an intercrop in many of the arecanut plantations in these districts. However, pepper is sparingly cultivated with other crops also in these districts. About 65% of the total area under pepper fall under the first category and 35% under the second. Based on this, the number of growers to be contacted is distributed between the two groups. In particular, 100 numbers of coffee estates have been selected at random from the districts in which pepper is cultivated in combination with coffee (the first group). Details are given in the table below.

Table A2 Number of farmers by district in the sample in Karnataka
(pepper cultivation mainly in combination with coffee)

District	Area under pepper (ha.)	Number of farmers surveyed	DES	KB
Chickmangalore	1917	49		49
Hassan	1350	19		19
Kodagu	2018	51		51
Total	5285	119		119

Source: Department of Horticulture, SB

Altogether, 150 farmers are contacted from Karnataka, which is 6% of the total number of growers of 2500 selected for the entire survey. The composition of area by crop combination as explained above is clearly (and not to our surprise, as the selection of farmers has deliberately been made this way) reflected in the tables on major crop combinations (Tables 4 and 5).

Weights required for extrapolation are calculated as the aggregate district area relative to the district area in the sample. In the first group, for example, the district-wise and state-wise aggregates are obtained by weighing variables of the observations in these districts with the aggregate coffee area in the district divided by the coffee area in the sample. Likewise weights may be calculated for districts where pepper is cultivated mainly in combination with arecanut. In formula this reads for the number of vines by district:

$$NV(d) = nv(d) \,.\, (A_{coffee}(d) / a_{coffee}(d))$$

where

$NV(d) = aggregate\ number\ of\ vines\ in\ district\ d$;

$nv(d) = number\ of\ vines\ in\ district\ d\ in\ the\ sample$;

$A_{coffee}(d) = aggregate\ district\ area\ cultivated\ with\ coffee$;

$a_{coffee}(d) = district\ sample\ area\ cultivated\ with\ coffee$

Production by district is estimated likewise. The area under pepper will be estimated based on the conversion factor of vines into area obtained by using density in pepper cultivation as observed in our survey (see Section 5 below). In the second group of districts, pepper is cultivated as pure crop as well as intercrop in arecanut plantations. Hence, a sample has to be selected from arecanut plantations as well as from pure plantations. The number of pepper vines in arecanut plantations can be estimated similar to the procedure explained for the first group. In this case, instead of taking total coffee area, total area under arecanut has to be taken in respect of a mixed situation. Since there is some pepper cultivation in other areas also, in addition to arecanut area, which is mainly pure cultivation, we have to take sample from this also. Therefore, the sample from the second group consists of arecanut plantations and a few samples selected at random from the pure pepper cultivation. It should be noted that the estimation procedure is only based on arecanut area.

Table A3 Number of farmers by district in the sample in Karnataka (pepper cultivation mainly in combination with arecanut)

District	Area under pepper (ha.)	Number of farmers Surveyed	DES	KB
Dakshina Kannada	1229	19		19
Shimoga	1400	2		2
Uttara Kannada	157	11		11
Total	2786	32		32

Source: Department of Horticulture, SB

In Tamil Nadu, pepper is mainly cultivated in the districts of Dindigul (Palani Hills), Coimbatore (Anamalai), Nilagiri (Gudallur), Salem (Yercaud) and Kanyakumari (Nagercoil). In the districts Dindigul, Coimbatore and Salem, pepper is cultivated along with coffee. In Nilagiri, pepper is usually planted with arecanut. In Kanyakumari, pepper is mainly cultivated as a pure crop. Based on the total area under pepper in Tamil Nadu and also the latest field indications, 50 growers are contacted during the survey. The distribution of these 50 growers by district is shown in Table A3. In the districts of Dindigul, Coimbatore and Salem, the number of pepper vines will be estimated using the area under coffee as explained for Karnataka. In the district Nilagiri, instead of coffee area, area under arecanut will be taken. In the case of Kanyakumari, the number of pepper vines will be estimated based on the total pepper area as reported by the official agencies (analogous to the procedure for Kerala).

Table A4 Number of farmers by district in the sample in Tamil Nadu

District	Area under pepper (ha.)	Number of farmers surveyed	DES	KB
Coimbatoire	125	1		1
Dindigul	307	18		18
Kanyakumari	74	5		5
Nilagiri	2049	15		15
Salem	474	12		12
Others	18			
Total	3047	51		51

Source: Department of Economics and Statistics,SB

5 Estimating area under pepper cultivation

A meaningful estimate of area under pepper cultivation would appropriately take account of the differences in types of cultivation in pepper (mixed cropping, mono cropping and homestead cultivation) and also of the differences in density of cultivation, particularly in mixed cropping, the major type of cultivation in pepper. At the start we are inclined to estimate area in the same way as production, i.e. by applying the appropriate sample weights to the area under pepper as reported by the household. This implies, for example, for the area under pepper by district in formula:

$$A_p(d) = \sum_h a_p(h,d).w(h,d)$$

The outcome of this calculation may be denoted as gross area cultivated with pepper. It is a gross concept as it does not take account of the differences in types of cultivation and in densities of cultivation, and it ignores the degree of utilisation of cultivable land. For example, an area of 0.5 acres under mixed cropping system with a density in pepper cultivation of 200 vines per acre, but also containing 300 coffee trees, contributes equally to aggregate gross pepper area as an area of 0.5 acres under mono cropping with a density of 400 vines per acre. And also equally to an area of 0.5 acres with 20 vines under homestead cultivation. The gross area concept is useful if an estimate is needed of the area allocated to pepper cultivation irrespective of other crops cultivated in combination with pepper on the very same plot/area. The gross area comes, conceptually, close to the calculation of area as implemented by DES: both ignores differences in cultivation type and density. Numerically, however, it is slightly different (see Table 12).

Gross area under pepper cultivation is an overestimate of the actual utilisation of cultivable area allocated to pepper vines, as a large part of this gross area is allocated to many other crops. Indeed, the larger part of pepper cultivation is under mixed cropping system and, hence, the concept of area under pepper should control for this. How should we control for this? Lets elaborate somewhat on the different types of cultivation. In Section 2 it is argued that the distinction between different types of cultivation (homestead cultivation, mixed and monocropping) is problematic in the sense that a large number of densities in pepper cultivation are observed that overlap with each other. Also homestead cultivation appeared conceptually

difficult. Partly for these reasons we limit the distinction in pepper area to pepper area cultivated under a mixed cropping system on the one hand and pepper area cultivated under other cropping systems, on the other hand. This distinction relates also to the use of cultivable area: the non mixed cropping area pertains either to area that is entirely cultivated with pepper (in the case of mono cropping), or is not cultivated because it is part of a homestead (in the case of homestead cultivation). In both cases the area for cultivation of agricultural crops is fully utilised, while it is **not** in the case of mixed cropping. In formula we may introduce this distinction as follows:

$$A_p(d) = \sum_h [a_{p,mix}(h,d) + a_{p,non-mix}(h,d)].w(h,d)$$

where

$a_{p,mix}$ = *area under pepper in mixed cropping in the sample*;

$a_{p,non-mix}$ = *area under pepper in other than mixed cropping in the sample*

In the adjustment from gross to net area we consider mixed cropping area and non-mixed cropping area separately. In the 'non mixed cropping' area, the gross area under pepper translates directly into net area, as the non-mixed cropping area fully covers the total cultivable potential of the respective areas. What is needed in the case of mixed cropping, is a method to weigh the mixed cropping area, where the weight should depend on the total number of crops on the specific plot.

$$A_p^*(d) = \sum_h [a_{p,mix}(h,d).\zeta(h,d) + a_{p,non-mix}(h,d)].w(h,d)$$

A possible candidate for weighing the mixed cropping area is to multiply the mixed cropping area with the density in pepper cultivation relative to the highest density in any type of cultivation. In formula:

$$\zeta(h,d) = \delta_{mix}(h,d)/\delta_{\max} \qquad 0 < \zeta(h,d) \leq 1$$

The intuition of this specification of the weight is simply the assertion that there is a particular value of density in pepper cultivation in which it may safely be assumed that the area is fully utilised and there is no scope for additional crops. A numerical example may clarify this. With a maximum density under mixed cropping of 800 vines per acre, a mixed cropping area of 2 acres with a density of 400 vines per acre only contributes for 50% of this area, i.e. for 1 acre, to the total area allocated to pepper cultivation. The next question is what value should be used for the maximum density of pepper cultivation under mixed cropping. From Table 7 it is observed that areas between 800 and 900 vines per acre are the ones with the highest density (all types of cultivation). Such densities are considered exceptional and not a representative measure of full utilisation of area. In our area estimates we have experimented with several values: in Table A5 the net area is shown with 400 and 600 vines per acre. The applied weight per household is restricted to having a value between 0 and 1: calculated household densities

that exceed the maximum level contribute to net area under pepper with a weight equal to 1 and not higher than 1.

The net area concept makes use of the qualitative information in our survey pertaining to the type of cultivation and the density in pepper cultivation, both on a household level (we use density in pepper cultivation by type of cultivation on a household level). In the DES methodology (see section 2 of this appendix) no distinction, whatsoever, is made in types of cultivation: a fixed density (1000 vines per hectare in Idukki and Wayanad and 560 vines per ha. in the remaining districts) is used to derive area, by mechanically dividing the number of vines with these standard densities. In our approach we use reported area and number of vines, both by type of cultivation, on a household level, and use the sample design to derive aggregates. Differences in densities of pepper cultivation between households is automatically accounted for. As a procedure the presented net area concept is better than the procedure proposed by DES.

Table A5 below shows the outcome of this exercise, the net area allocated to pepper cultivation. Unfortunately this figure is difficult to compare with other estimates of area under pepper, because these estimate have an entirely different conceptual basis. At this stage we may observe that for Kerala districts the level of the official figure is on the whole lower than the different net area concepts developed in this section, while the reverse is the case for Karnataka districts. The all Tamil Nadu net pepper area comes closer to the official figure. As opposed to the absolute size of the area under pepper by district, the distribution of area under pepper over districts may be compared. From this distribution (see Table A5) we learn that around 73% of pepper area in Kerala is located in Idukki, Kannur and Wayanad, as opposed to 64% according to the official data. In some instances the area allocated to the cultivation of pepper increases or decreases dramatically relative to the DES area. On the whole we may conclude that the distribution of (net) area allocated to the cultivation of pepper, calculated with the area concept developed in this section, diverges substantially from the DES distribution.

Table A5 Area under pepper cultivation by district and state (in hectares)

	Gross area	district share in %	Net area δ_{max}=400	District share in %	net area δ_{max}=600	District share in %	official data *	district share in %
Kerala								
Alapuzha	4120	1.0	535	0.5	357	0.4	1739	1.0
Ernakulam	26162	6.5	3597	3.1	3458	3.9	5837	3.2
Idukki	57407	14.3	36880	31.4	28994	32.8	47712	26.1
Kannur	77635	19.3	11227	9.6	9510	10.7	30148	16.5
Kasargode	22192	5.5	2217	1.9	2020	2.3	4647	2.5
Kollam	15537	3.9	4131	3.5	2895	3.3	8663	4.7
Kottayam	14492	3.6	4330	3.7	2967	3.4	8219	4.5
Kozhikode	21356	5.3	4979	4.2	3360	3.8	10302	5.6
Malapurram	14864	3.7	3561	3.0	2382	2.7	8193	4.5
Palakkad	7216	1.8	1855	1.6	1266	1.4	4073	2.2
Pathanamthitta	8979	2.2	1824	1.6	1237	1.4	4235	2.3
Thiruvananthapuram	14414	3.6	2801	2.4	1960	2.2	5171	2.8
Thrissur	10601	2.6	1617	1.4	1509	1.7	4343	2.4
Wayanad	106605	26.5	37939	32.3	26605	30.1	39605	21.7
All Kerala	401580		117493		88520		182887	
Karnataka								
Chickmagalur	56585	35.4	6346	15.0	4231	13.9	1917	23.8
Dakshina Kannada	10269	6.4	943	2.2	628	2.1	1229	15.2
Hassan	18530	11.6	6741	15.9	4494	14.8	1350	16.7
Kodagu	59883	37.5	20097	47.5	13465	44.2	2018	25.0
Shimoga	8287	5.2	6651	15.7	6615	21.7	1400	17.3
Uttara Kannada	6091	3.8	1518	3.6	1012	3.3	157	1.9
All Karnataka	159645		42296		30445		8071	
Tamil Nadu								
Coimbatoire	2808	8.5	380	6.7	253	6.5	130	4.0
Dindigul	15058	45.8	2872	50.6	2009	51.4	631	19.4
Kanyakumari	137	0.4	37	0.7	24	0.6	72	2.2
Nilagiri	8465	25.7	931	16.4	652	16.7	2005	61.7
Salem	6431	19.5	1457	25.7	972	24.9	411	12.7
All Tamil Nadu	32899		5677		3910		3249	

Source: SB, ESI-VU, 1997

* Kerala: Department of Economics and Statistics,Trivandrum, 1996-97;
Karnataka: Department of Horticulture,
Tamil Nadu: Department of Economics and Statistics,Tamil Nadu, 1996-97.

Appendix B: Questionnaire for a survey among pepper farmers

INDO-DUTCH PROGRAM ON ALTERNATIVES IN DEVELOPMENT (IDPAD)

PEPPER CULTIVATION IN INDIA

JOINT PROJECT BY
THE SPICES BOARD OF INDIA
AND
THE ECONOMIC AND SOCIAL INSTITUTE, FREE UNIVERSITY, AMSTERDAM

QUESTIONNAIRE FOR THE COLLECTION OF
ANNUAL DATA ON PEPPER CULTIVATION
(LARGE SAMPLE)

Farm household questionnaire

1 **Name of enumerator**

.....

2 **Name & address of the head of the household**

.....

.....

.....

3 **Name of interviewee and relation to head**

.....

4 **General Information**

(a) Village ..... (b) Taluk ..... (c) Block .....

(d) District ..... (e) State ..... FAL

Cultivated area

5 **What is the total size of your area (in acres) in 97-98?** ☐

What has been the total size of your area (in acres) the last three years?
(only if different from above)

94-95 ☐ 95-96 ☐ 96-97 ☐

Could you give a break-up of your total area by type of cultivation in 97-98?

	type of cultivation * (a)	area in acres	crop code (b) and number of trees									
			crop	no	crop	No	crop	no	crop	no	crop	no
A												
B												
C												
D												
E												
F												

(a)
1 = homestead 1 = pepper
2 = mixed/multi cropping
3 = mono cropping

(b)
6 = plantain 11 = natural rubber 16 = shade trees
2 = coffee 7 = tea 12 = paddy 17 = support trees
3 = cardamom 8 = cashewnut 13 = other grains 18 = no crop
4 = coconut 9 = pineapple 14 = cassave 19 = other (specify): ..
5 = arecanut 10 = oil palm 15 = other vegetables

* Note that more than one type of mixed ormulti cropping (eg. coffee and pepper on one plot, and pepper and cardamom on another) should be entered as a separate entry in the answering table. The farmer should be asked to make such a distinction.

6 **Could you give an age-wise break-up of your pepper area in 97-98?**

*	total number of vines	number of vines by age group						
		0-1	2-3	4-7	8-11	12-15	16-19	>20
A								
B								
C								
D								
E								
F								

* area by type of cultivation should correspond with question 5;

7 **Could you give a variety-wise break-up of your pepper area in 97-98?**

*	number of vines by variety (a)									
	variety	no.	variety	no.	variety	No.	variety	no.	variety	no.
A										
B										
C										
D										
E										
F										

* area by type of cultivation should correspond with question 5.

(a)
1 = Karimunda 6 = Vellamundi
2 = Panniyur I 7 = Chettan
3 = Kulluvally 8 = Neelamundi
4 = Kottanadan 9 = Wynadan
5 = Balankotta 10 = other (specify): ..

Investment and investment plans

8 **Did you uproot crops in the last three years? yes/no**

If yes:

crop uprooted (a)	number of plants / trees	which crop year?	crop cultivated after uprooting (a)	area in acres	reason (b)

(a)

1 = pepper 6 = plantain 11 = tea
2 = coffee 7 = natural rubber 12 = paddy
3 = cardamom 8 = cashewnut 13 = cassave
4 = coconut 9 = pineapple 14 = no crop
5 = arecanut 10 = oil palm 15 = other: ..

(b)

1 = declining price crop planned to uproot
2 = rising price of crop planned to cultivate
3 = old and senile standing crops
4 = increase in labour costs
5 = increase in material costs
6 = incidence of disease or drought
7 = other (specify): ..

9 **Are you planning to uproot crop(s) next season? yes/no**

If yes:

crop planned to be uprooted (a)	Number of plants / trees	crop planned to be cultivated (a)	area in acres	reason (b)

(a)

1 = pepper 6 = plantain 11 = tea
2 = coffee 7 = natural rubber 12 = paddy
3 = cardamom 8 = cashewnut 13 = cassave
4 = coconut 9 = pineapple 14 = no crop
5 = arecanut 10 = oil palm 15 = other: ..

(b)

1 = declining price crop planned to uproot
2 = rising price of crop planned to cultivate
3 = old and senile standing crops
4 = increase in labour costs
5 = increase in material costs
6 = incidence of disease or drought
7 = other (specify): ..

Harvest of pepper

10 **How much of pepper did you harvest in 96-97?**
Against which price did you sell and to whom?
And how much is still in store?

stocks in kg per 8/96	harvest in kg	sales*		sold to (b)	stocks in kg per 8/97
		kg	Rs		

(b) (b)
1 = village merchant 6 = agent of wholesaler
2 = local dealer 7 = agent of processing industry
3 = wholesaler 8 = agent of export dealer
4 = export dealer 9 = exporter
5 = agent of exporter 10 = other (specify): ..

* after 8/96 sales include sales of stocks;

11 **Could you give a variety-wise break-up of your pepper harvest of the year 96-97?**

variety (a)	harvest in kg (dry weight)

(a)
1 = Karimunda 6 = Vellamundi
2 = Panniyur I 7 = Chettan
3 = Kulluvally 8 = Narayakodi
4 = Kottanadan 9 = Neelamundi
5 = Balankotta 10 = other (specify): ..

12 **What has been your total pepper production over theyears?**

	95-96	94-95
total production in kg (dry weight)		

Expected production of pepper

13 **What is the normal level of production for your area assuming average weather conditions over the whole season?**

kg

What is your expected total production for the year 97-98?

kg

14 Remarks of the enumerator

Date of visit ...

Place ...

Name and signature of the enumerator ... ...

15 Remarks of the supervising officer

Date of visit ...

Place ...

Name and signature of the supervising officer ... ...

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